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Chesapeake UTILITIES CORPORATION

February 16, 1994

Randy Sturgeon
Remedial Project Manager
United States Environmental Protection Agency
Region III (3HW42)
841 Chestnut Building
Philadelphia, Pennsylvania 19107

Dear Mr. Sturgeon,

This is in accordance with our discussions on January 16, 1994. Enclosed is a copy of the Phase IA/IIA Archaeological Study Report for the Dover Gas Light Site, Dover, Delaware. This includes a work plan in the even excavation is necessary during remediation. If I may be of further assistance, please contact me at (302) 734-6787.

Sincerely,

Edward Dunlap

Edward Dunlap
Engineering Manager

Enclosure

P.O. BOX 1769 • DOVER, DELAWARE 19903 • 302/734-6007

Phase IA/IIA Study
of the
Dover Gas Light Site
Dover, Delaware

by

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Submitted to:

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ABSTRACT

This Phase IA/IIA Study of the Dover Gas Light Superfund Site ("the site") in Dover, Delaware was conducted by Engineering-Science under contract to Versar, Inc. of Springfield, Virginia and Consoer, Townsend & Associates of Fairfax, Virginia for Chesapeake Utilities Corporation of Dover, Delaware. Chesapeake Utilities Corporation agreed to conduct a Remedial Investigation/Feasibility Study (RI/FS) in accordance with the Administrative Order By Consent executed by Delaware Department of Natural Resources and Environmental Control (DNREC), United States Environmental Protection Agency (EPA) Region III, and Chesapeake Utilities.

This investigation was performed as part of the RI/FS for the site in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended. Section 106 requires that:

> The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register (16 U.S.C. 470f).

The site is included on the National Register as part of the Delaware State Museum site, also known by the historic name *Old Presbyterian Church* complex. The National Register nomination did not include consideration of archaeological resources on the property, and thus the present study was conducted to identify the potential for such resources on the site, and to evaluate whether they might be eligible for inclusion in the National Register of Historic Places. This activity must be conducted prior to implementation of remediation action on the site.

Archaeological work was carried out in accordance with the standards of the Advisory Council on Historic Preservation and the National Park Service (36CFR800; 36CFR66), and the "Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation" (48 FR 44716-44742).

In 1991, historical research was conducted for a Phase IA archeological assessment in conjunction with an on-site geophysical study and soil borings. In January and February 1992, additional historical and archival research was conducted for a Phase IIA archaeological study. The intent of these studies was (1) to assess the potential archaeological deposits associated with historical activities at the site; (2) to determine the potential significance of any such resources; (3) to evaluate the need for subsurface archaeological investigations; and (4) to recommend methods for subsurface archaeological investigations that would locate and identify such resources in a manner that would permit evaluation of their significance, and provide the best opportunity for data recovery, in the event significant remedial activities are conducted on site in areas of potential archaeological significance. Since potentially hazardous materials are present at certain locations on the site, recommendations for subsurface testing would

be designed to meet the goals of the National Register evaluation, while also minimizing exposure to potentially hazardous materials.

The potential resources on the site were evaluated in reference to Delaware's State Preservation Plan and a predictive model and research questions were developed. The potential archaeological resources may include structural and material remains associated with the former manufactured gas plant, as well as with several domestic structures, which stood on the site at one time. The two historical periods which are most relevant to the Dover Gas Light Site are *Industrialization and Early Urbanization* (1830-1880+/-) and *Urbanization and Early Suburbanization* (1880-1940+/-). The former plant most closely corresponds to the historic theme, "manufacturing" and the subtheme, "chemical production and processing." Although the Dover Gas Plant eventually came under public regulation, its period of greatest importance occurred under private ownership, and its importance relates to its role in technological and urban development rather than as a governmental service. The domestic structures fit into the historic theme of "settlement patterns and demographic change."

Archaeological field investigation is recommended in the event that remediation efforts require subsurface excavation which would impact potential archaeological resources. The scope of the archaeological work will be designed so as to best address the research questions while minimizing health and safety risks. The archaeological field investigation will be accomplished in a single episode and will be limited to a period of four weeks, as was agreed to in the September 18, 1992 meeting with EPA, DNREC, and the Delaware SHPO.

Archaeological work would be necessary in those areas disturbed by remedial excavation, to the extent that potentially significant archaeological resources have been predicted in those areas of the site. Should archaeological fieldwork be required, it is recommended that an investigation be conducted (1) to determine the presence or absence of archaeological resources at locations on the site with the highest potential for significant resources to be present; (2) to assess the integrity of any such resources discovered; (3) to evaluate their eligibility for the National Register of Historic Places; and (4) to recover archaeological data related to the historic use of the property. Prior to the initiation of the fieldwork, a detailed Work Plan and a Health and Safety Plan will be developed. Because of the possibility of encountering potentially hazardous materials, appropriate precautions will be employed when conducting subsurface archaeological investigations. Archaeologists working on the site will have completed the appropriate OSHA 40-hour training (29CFR1910.120).

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ACKNOWLEDGEMENTS

We would like to thank the following persons and institutions for their assistance in the completion of this project: Art Jung, Lori Stowers, Bill Di Guiseppi of Consoer, Townsend & Associates; Dave Durant of Versar, Inc.; Ed Dunlap of Chesapeake Utilities; Steve Johnson of the Delaware Department of Natural Resources; Randy Sturgeon and John Vetter of the EPA; Faye Stocum and Alice Guerrant, Delaware State Preservation Office, and Chuck Fithian, Delaware State Museum, for providing information on archaeological resources and ongoing research in Dover and the state of Delaware; Ned Heite for providing his personal memories of the site, names of individuals to interview regarding the plant closing, and information on the cannery site; Cara Bloom for information on the State House research; Jim Stewart, Bureau of Museums and Historic Sites; and Randy Goss, Doris Carignan and Tabitha Wyatt, archivists at the Delaware State Archives, the staff at the Delaware Historical Society and the Hagley Museum, for their assistance with historical research.

I. INTRODUCTION

A. Purpose of Report

This Phase IA/IIA study of the Dover Gas Light Superfund Site ("the site") in Dover, Delaware was conducted by Engineering-Science under contract to Versar, Inc. of Springfield, Virginia and Consoer, Townsend and Associates of Fairfax, Virginia, for Chesapeake Utilities Corporation of Dover, Delaware. Chesapeake Utilities Corporation agreed to conduct a Remedial Investigation/Feasibility Study (RI/FS) in accordance with the Administrative Order By Consent executed by Delaware Department of Natural Resources and Environmental Control (DNREC), United States Environmental Protection Agency (EPA) Region III, and Chesapeake Utilities.

This report is one of four related reports that have been submitted in the course of preparing the RI/FS for the site. The first three reports consist of On-site Source Characterization Study (Versar 1991a); an Aerial Photographic/Historical Map Investigation Report (Versar 1991b); and an Electro-Magnetometry/Ground-Penetrating Radar (EM/GPR) Survey conducted by Engineering-Science (Bowers 1991).

The archaeological investigation was performed as part of the RI/FS for this site in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended. Section 106 requires that:

> The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register (16 U.S.C. 470f).

Archaeological work was carried out in accordance with the standards of the Advisory Council on Historic Preservation and the National Park Service (36CFR800; 36CFR66), and the "Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation" (48 FR 44716-44742).

The site is included on the National Register of Historic Places as part of the Delaware State Museum site, also known by the historic name *Old Presbyterian Church* complex. The National Register nomination did not include consideration of archaeological resources on the property, and thus the present study was conducted to identify potential archaeological resources on the site, and to evaluate whether they might be eligible for inclusion in the National Register of Historic Places (NRHP). The Section 106 process must be conducted prior to implementation of remediation action on the site. Should the site area be capped and the archaeological remains be undisturbed, the Section 106 process will conclude with a statement of "no effect."

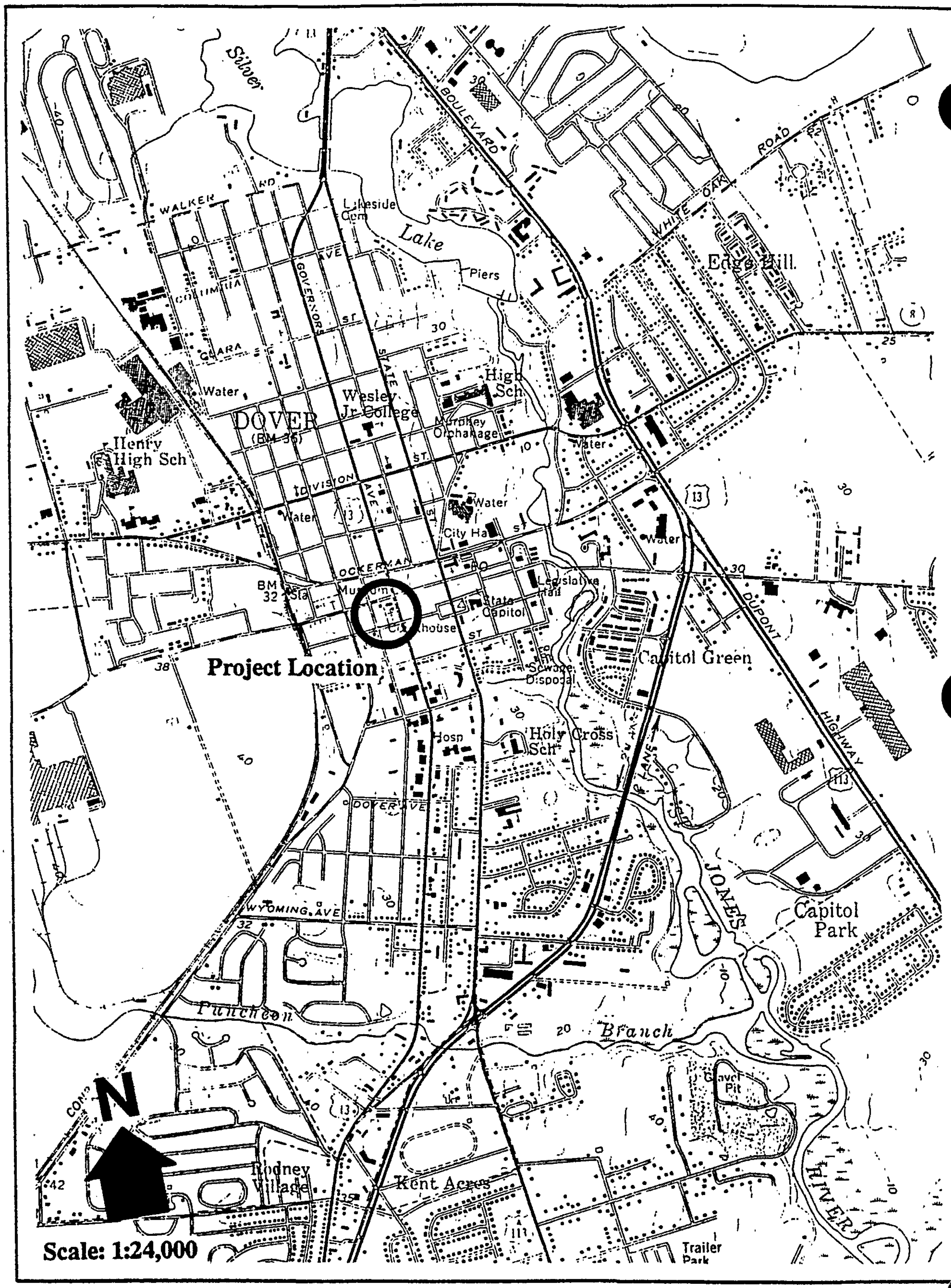
The purpose of this Phase IA/IIA study was to identify and evaluate the potential archaeological resources on the site by means of historical and archival research, in combination with an analysis of the results of an on-site geophysical study and soil borings. Ordinarily, subsurface archaeological testing is conducted at the Phase I level to determine the presence or absence of archaeological resources and at the Phase II level to determine site integrity, site boundaries, cultural affiliation and to evaluate the site for eligibility to the NRHP. Due to the potentially hazardous nature of materials on the site, it was decided that intensive archival research (the Phase IA/IIA Study) would precede a single episode of subsurface archaeological investigation. Because the actual presence of archaeological resources has not been verified, *potential* archaeological resources are discussed in terms of their *potential* significance. The findings of the archival research in combination with an archaeological evaluation of the soil borings and the results of the geophysical survey have been used to develop a predictive model for the presence of archaeological resources.

B. Project Location And Description

The site is located in Kent County, Delaware, within the limits of the city of Dover (*Figure 1*). The site occupies the western half of the city block bounded by New Street, Bank Lane, North Street, and Governors Avenue (*Figure 2*). The northern portion of the site is currently used as a parking area for the Delaware State Museum and is paved with gravel. The Eldridge Reeves Johnson Memorial Building is present on the southern portion of the site. Site topography is generally flat, with the exception of a 30- by 40-foot grassy area on the east side of the site. The surface of this grassy area is approximately 2 feet higher than the rest of the site and contains a chain link fence and several trees.

This site is included on the National Register of Historic Places as part of the Delaware State Museum site, also known by the historic name *Old Presbyterian Church* complex. The property was reserved as Meeting House Square on the original plot of Dover, laid down in 1717. Four buildings were identified within the National Register property in 1972. At the time, Building Number 3 was identified as "the office of a gas plant." This structure was damaged by fire, demolished in 1985, and removed for disposal. Nevertheless, the property is still included in the National Register of Historic Places. Of the three other buildings extant on the site, only the Old Presbyterian Church and the brick chapel are included on the National Register. Of recent construction, the Johnson building is not listed on the nomination.

The site of the former manufactured gas plant is 2200 feet west of the St. Jones River [Creek]. Conrail tracks (formerly the Delaware Railroad) lie in a north-south direction several blocks west of the gas works site. The public square and governmental buildings are located several blocks to the east. The former Presbyterian Church and Cemetery, now owned by the Delaware State Museum, occupies the eastern portion of this block.



Source: USGS/ Dover, DE

Dover Gas Light

Figure 1
Project Location Map

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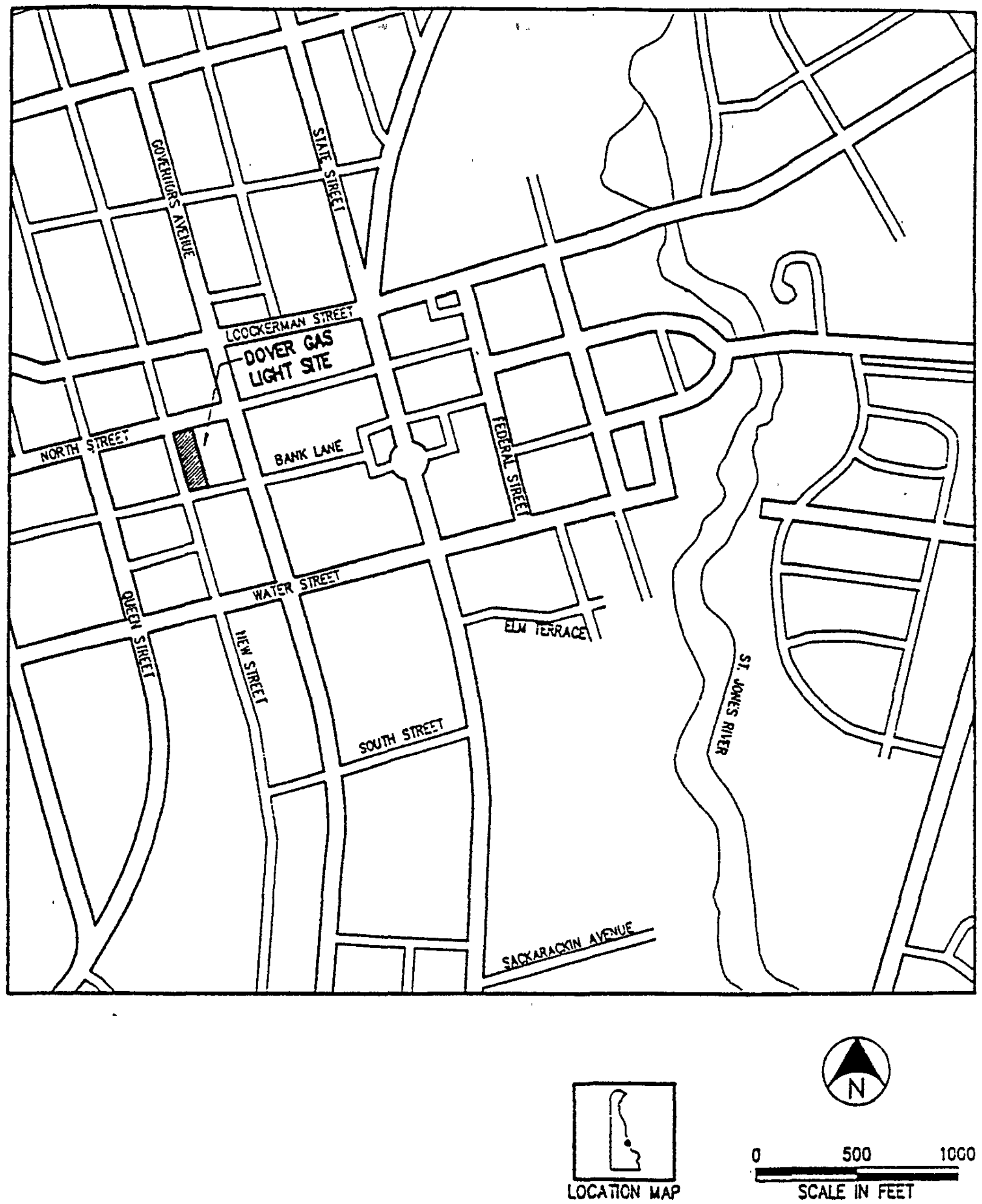


Source: Versar

Dover Gas Light

Figure 2
Site Map

The manufactured gas plant produced gas for industrial, commercial, and residential use, as well as street lighting. The plant, which operated from 1859 until 1948 when operations ceased, was dismantled between 1948 and 1949. At the completion of demolition activities, one building was left standing; other structures were removed for off-site disposal; and some debris was reportedly buried on-site.

C. Project Objective

The goal of the current study was (1) to assess the potential archaeological deposits associated with historical activities at the site; (2) to determine the potential significance of any such resources; (3) to evaluate the need for subsurface archaeological investigations; and (4) to recommend methods for subsurface archaeological investigations that would locate and identify such resources in a manner that would permit evaluation of their significance, and provide the best opportunity for data recovery. Since potentially hazardous materials are present at certain locations on the site, recommendations for subsurface testing would be designed to meet the goals of the National Register evaluation, while also minimizing exposure to potentially hazardous materials.

II. METHODOLOGY

A. Archival Procedures

In order to assess the site's potential archaeological significance, historical and archival research was undertaken in Washington, D.C., and in Dover and Wilmington, Delaware. The research was directed toward understanding land use prior to the construction of the gas works in the 1850s, as well as the subsequent evolution and development of the site. Features were identified by examining historic maps and plats which indicated the locations of now-demolished building and structures. Research also focused on the operation and demolition of the Dover Gas Light manufactured gas plant, and on understanding the historic process of coal gas manufacture, particularly how the technology influenced both above-ground and subsurface development. This data will assist in more accurately determining the location of trenches for potential archaeological testing.

The Bureau of Museum and Historic Sites of the State of Delaware was consulted initially. As administrators of the site, now owned by the State, the Bureau maintain a file of historical materials about the property. Deeds, maps, published local histories, and photographs, both historic and current, were obtained from the Hall of Records in Dover. The Delaware Comprehensive Historic Preservation Plan was consulted for evaluating the potential significance of the site and the development of the predictive model. The Hagley Museum and the Delaware Historical Society were also consulted for information regarding the Dover Gas Plant and other gas works. Copies of depositions taken in 1988 from former Dover Gas Light Company employees and local Dover residents were reviewed for information pertinent to the locations of structures, types of equipment and operations, and demolition of the plant in the late 1940s. Several oral history interviews were conducted in order to clarify the demolition process. Additionally, EPA Technology Transfer documents pertaining to manufactured gas plant sites were reviewed. Documentation of other gas works in the United States was obtained from the Historic American Engineering Record (HAER) of the National Park Service. Finally, primary and secondary materials from the Library of Congress were examined.

Notes and background materials gathered as part of this documentation are stored with project files at Engineering-Science, 1133 15th Street, N.W., Washington, D.C.

B. Field Procedures

A geophysical survey, monitored by an archaeologist, was conducted to determine the presence of any subsurface archaeological features. The survey methods used were Electromagnetometry (EM) and Ground Penetrating Radar (GPR). EM was used to locate anomalous areas in the subsurface materials at the site. These anomalous areas were located by collecting quadrature phase and inphase magnetic field measurements at the grid nodes along the survey traverses. These same traverses were also crossed with the GPR. This gave ES cross-sectionional and plan-view representations of the subsurface. Information generated during the EM and GPR surveys was integrated to give a representative interpretation of the subsurface.

The inphase component of the magnetic field was the first subsurface geophysical parameter measured at the Dover Gas Light Site. Strong anomalous areas were observed at the site. The majority of these anomalies centered at depths of 5 feet to 10 feet below the ground surface. Several of these anomalies could be explained by cultural features observed at the surface, ex. an iron railing, located above the water lines leading into the museum building and above ground utilities. It should also be noted that the inphase measurements were more affected by the museum building than the quadrature phase measurements.

A general statement may be made concerning the EM inphase magnetic field observations at the site. Conductivities are higher in the northern one-third and western one-fifth of the site. The higher readings in the western one-fifth of the site may be explained by the presence of overhead utility lines and the presence of parked automobiles along New Street.

The GPR was not affected by the cultural features found on or above the ground surface at the site. Areas where the GPR image produced by the profiler was degraded and the reflected signal was diminished were also encountered. The degradation of the GPR reflected signal is encountered where the material being scanned is not penetrated by the electromagnetic signal. These areas were apparent north of the 100 east-west line to the 195 east-west line between the 100 and 80 north-south lines and extending over the site westward to the 115 north-south line from the 0 north-south line. The degraded signal continued along an axis which ran through the center of the site and thinned as it continued north before ending at the 300 east-west line. The degraded GPR image may also be indicative of changed conditions in the subsurface materials.

A complete description of the methods employed and results can be found in *Dover Gas Light Geophysical Explorations* (Engineering-Science 1991 - Appendix B).

Soil borings were monitored by an archaeologist to assist in determining the potential for archaeological resources in the project area. Soil profiles were drawn to vertical scale for each soil boring, and descriptions of each stratum were recorded. The location of all soil borings was recorded on a site map.

Data from each of these categories were analyzed. Historical documentation provided information on the nature of the coal gasification process and the former location of structures and associated features. Findings from the geophysical survey and the soil borings as well as the historical documentation assisted in the prediction of the location of archaeological resources and the depth and nature of the fill. These data are summarized and evaluated in the following sections of the report.

III. BACKGROUND

A. General Site Description

The site is located in the Atlantic Coastal Plain physiographic province in the eastern half of Delaware. Dover is within the Low Coastal Plain environmental zone which includes most of Kent and Sussex Counties (Custer 1986:13). The land surface slopes gradually toward the east and the St. Jones River.

The Atlantic Coastal Plain is composed of sediments deposited during the Cretaceous, Tertiary and Quaternary Periods. The formation of importance to this study includes the Columbia Formation of the Pleistocene Epoch. Underlying this is the Chesapeake Group of the Miocene Epoch. All of the underlying deposits dip to the southeast and increase in thickness from north to south in Kent County. The Columbia Formation is composed of yellow, brown and white fine to coarse sands and gravels and some clay stringers. The thickness is highly variable, but is at least 40 feet thick in the Dover area. The Chesapeake Group comprises blue to gray silts, shells and fine to medium sands. In the Dover area, at least two sands are persistent and are known as the Frederica (upper) and Cheswold (lower) aquifers. In the immediate vicinity of the site, the Columbia Formation is approximately 58 to 65 feet thick and overlies the Miocene sediments.

B. Prehistoric Background

This section relates generally to the prehistoric periods of Delaware, which are not intended to be specific to the site itself.

The site is located in the State of Delaware, which lies in the Middle Atlantic region of the eastern United States. The prehistory of Delaware has been divided into four major periods (Custer 1984; 1986): the Paleo-Indian (*ca.* 12,000 B.C. - 6500 B.C.), the Archaic Period (*ca.* 6500 B.C. - 3000 B.C.), the Woodland I Period (*ca.* 3000 B.C. - A.D. 1000), and the Woodland II Period (A.D. 1000 - A.D. 1650) (Custer 1984). The following description follows Jay Custer's work in this area.

These cultural periods represent a taxonomic device whereby changes in material culture and subsistence strategies are emphasized. Shifts in the types of artifacts used often reflect technological transformations, which can be seen as adaptive responses to changing environmental conditions (Allan and Stuart 1977). Thus a discussion of the archaeological background of Delaware must combine aspects of the environment, subsistence base, and artifactual record. The model for prehistoric site distribution that results from such a discussion enables archaeologists to predict the most likely locations for sites of the different periods (Gardner 1978, 1982; Bromberg 1987). A model of this nature is a useful tool for preservationists, for it allows them to judge the likelihood of finding sites in areas slated for development.

The record of human habitation in Delaware began some 12,000 to 14,000 years ago, concurrent with the final retreat of the Wisconsin polar ice cap. Pollen profiles from the area indicate a predominance of spruce and pine elements in the region, with an influx of oak as temperatures rose. Thus, the replacement of the parkland or tundra conditions of glacial times by boreal forests had begun by the time of Paleo-Indian occupation of the area. The current consensus is that the large Pleistocene herd animals hunted by Paleo-Indians in the western United States were probably no longer present in abundance in the Middle Atlantic by about 10,000 B.C., and it is therefore postulated that smaller game and a variety of plants were most likely the main resources exploited in the region during the Paleo-Indian period (Custer 1989).

The characteristic artifact of Paleo-Indian times is the fluted stone point, often made of high quality cryptocrystalline lithic material such as chert or jasper (Gardner 1974a, 1974b, 1979). These points, used as spear tips, are relatively rare throughout the region. The points are usually found alone, without other artifacts nearby, and it is unclear whether they represent camp sites or were lost during a hunting trip. Excavation of these sites has indicated a tendency for Paleo-Indian base camps to be located in areas of maximum habitat overlap near sources of cryptocrystalline stone (Gardner 1974a, 1974b, 1979). Other smaller, more temporary camp sites were situated nearby to serve a variety of purposes, and the even more ephemeral hunting camps were often further from the base camp location (Gardner 1974a, 1974b, 1979). A similar pattern has been noted for areas in northern Delaware where cryptocrystalline stone is available (Custer and DeSantis 1986). In central Delaware where this high quality lithic material is not available, Custer and DeSantis (1986) have suggested that the more permanent base camps were located on well drained ridges in areas of maximum habitat overlap, with the smaller camps nearby, and the hunting sites farther removed.

The Delaware Coastal Plain was favorable for Paleo-Indian occupation and numerous sites are known from this period. Most of these sites are associated with poorly drained swampy areas and include the Hughes Paleo-Indian complex near Felton (Custer and Cunningham 1986:15).

The Archaic Period in Delaware lasted from about 6500 B.C. to 3000 B.C. A generalized foraging pattern served to exploit the resources available during this period. As the foragers spread out in search of game and vegetable resources, they began to use locally available materials for tool manufacture.

The Archaic Period is characterized by a series of adaptations to the newly emerged full Holocene environments. These environments differed from earlier ones and were dominated by mesic forest of oak and hemlock. A reduction in open grasslands contributed to the extinction of many of the grazing animals hunted during Paleo-Indian times; however, grazing species such as deer flourished. Adaptations from the hunting focus of the Paleo-Indian to a more generalized foraging pattern in which plant food resources and grassland species are associated with the beginning of the Holocene Period in Delaware. Sea level rise is also associated with the beginning of the Holocene Period, which would have raised the local water table. This would have helped to create a number of large interior swamps. Adaptations changed from the hunting focus of the Paleo-Indian Period to a more generalized foraging pattern in which plant food resources played an important role. Large swamp settings apparently supported large base camps. A number of small procurement sites in favorable hunting and gathering locations such as bay/basin features are known from the Coastal Plain.

Tool kits were more generalized than in the earlier period, and showed a wider array of plant processing tools such as grinding stones, mortars, and pestles. A mobile lifestyle was probably common, with a shifting band level organization and varying size of group relative to resource availability. Known sites include large base camps such as the Clyde Farm site in northern Delaware, and smaller processing sites at a variety of locations.

The Woodland I Period (3000 B.C. - A.D. 1000) can be correlated with a dramatic change in local climates and environments that seem to be part of events occurring throughout the region (Custer, Bachman and Grettler 1986:19). This was an interval of shifting wet and dry climates, and in some areas mesic forests were replaced by xeric forests of oak and hickory. Grasslands also became common. Continued increase in the sea level made many areas of the Delaware River and Bay shore the sites of large brackish water marshes which are especially high in productivity. This change in environment and resource distribution caused a radical shift in adaptations for prehistoric populations. Important areas for settlements included the major river floodplains and estuarine swamp areas. Large base camps with fairly large numbers of people are evident in many settings in the Delaware Coastal Plain, such as the Barker's Landing, Coverdale, Hell Island, and Robbins Farm sites. These sites seem to have supported more people than previous base camp sites and may have been occupied on a year-round basis. An overall tendency toward a more sedentary lifestyle is also apparent. Gardner (1982) has postulated that, rather than breaking up into small base camps in interior freshwater settings, occupants of the large spring/summer base camps in anadromous fishing zones regrouped in the fall and winter near the freshwater/saltwater transition to take advantage of the abundant shellfish resources there.

The tool kits vary from the previous period and include some major additions. Plant processing tools become even more common and seem to indicate intensive harvesting of wild plant foods. Chipped stone tools changed little from the previous period; however, broad-blade, knife-like processing tools become more prevalent. Storage pits and semi-subterranean houses also are known to exist in the region during this period.

Relatively sedentary lifestyles and intensified food production may have produced occasional food surpluses, which may have allowed the development of incipient ranked societies. These are indicated by the presence of extensive trade and exchange in lithic materials for tools, as well as non-utilitarian artifacts, caching of special artifact forms and utilization of artifacts made from exotic raw material. By the end of the Woodland I Period in Delaware (A.D. 1000), a relatively sedentary lifestyle is evident in the Coastal Plain, especially in the Mid-Drainage zone.

The Woodland II Period (A.D. 1000 - A.D. 1650) is often marked by the appearance of agricultural food production systems; however, in the Delaware Coastal Plain there are no clear indications of such a shift. There are very few changes in basic lifestyles and overall artifact assemblages during this period. Intensive plant utilization and hunting remain the major subsistence activities, with some evidence of an increasing reliance on plant foods and coastal resources throughout the Woodland II Period. Social organization changes are evidenced by a collapse of the trade and exchange networks and the end of the appearance of elaborate cemeteries.

The Contact Period (A.D. 1650 - A.D. 1750) is poorly documented in the archaeological record of Delaware (Custer and Cunningham 1986:26). It has been postulated that Native American groups of Delaware were less visible in interaction with Europeans than in surrounding areas of Maryland and Pennsylvania. Those that did remain were under the domination of the Susquehannock Indians of southern Lancaster County, Pennsylvania (Custer and Cunningham 1986:26).

1. Prehistoric Period Research Design

Discussion of the archaeological background of Delaware combines aspects of the environment, subsistence base and artifactual record (see Chapter IV). The model for prehistoric site distribution that results from such a discussion enables archaeologists to predict the most likely locations for sites of the different periods (Gardner 1978, 1982; Bromberg 1987). Custer (1986), following Gardner's (1978) method, has developed study areas for prehistoric sites in Delaware.

The project area lies in the Mid-Drainage Zone of the Lower Coastal Plain of Delaware (Custer 1986:15). This area includes the central sections of all the Coastal Plain tributaries of the Delaware River and consists of both poorly drained and well drained soils. The former are located in the floodplains of the major drainages, the latter in the upper terraces of the drainages and on isolated headlands between major drainages and their tributaries (Custer 1986:15). St. Jones River runs through Dover approximately 3000 feet east of the project area. Historic maps indicate that a smaller drainage, known first as Meeting House Branch and then as Tar Branch, ran about 250 feet to the southwest of the project area.

Custer has plotted the locations of Paleo-Indian sites on the Delmarva peninsula. He finds three areas of concentration: northeastern Cecil County, Maryland; near the mouths of the Choptank and Nanticoke Rivers; and along the Mid-Peninsular Drainage Divide, the Zone to the east of the Mid-Drainage Zone. Scattered sites have also been found in the Mid-Drainage and Coastal Plain (Custer 1986:46-49). Two settlement patterns occur: a quarry pattern and a non-quarry pattern. The former is expected in the northern part of the state, the latter along the Mid-Peninsular Drainage Divide (Custer 1986:51-52). The project area falls into an area lacking large lithic resources and game attractive areas. The expectation of Paleo-Indian sites in this area is low. Due to the paucity of available data, however, any conclusions in this regard must be considered with caution (Custer 1986:52).

Custer similarly develops study areas for the Archaic period. Few Archaic sites have been found in Delaware; therefore, they have been studied along with Archaic sites in other areas of the Mid-Atlantic in order to form the predictive model (Custer 1986:63). The three major kinds of Archaic sites are described as Macro-band base camps, Micro-band base camps and procurement sites (Custer 1986:66-67). Four major settlement systems, consisting of a combination of the above named types, are predicted for Delaware. These are located: in the Piedmont Uplands; along the major drainages; near large freshwater swamps; and in the Mid-Peninsular Drainage area. The project area is located in a fifth category, for which little data is available (Custer 1986:76-81).

Of the four defined Prehistoric cultural periods, the Woodland I Period is the most well represented in Delaware. In general, during this period, there is a reduction in the variety of macro-band base camps locations. These tend to be located in areas characterized by reliable surface water and high productivity in hunted and gathered resources (Custer 1986:106). The camps themselves tend to be larger in size than in the Archaic period and reflect increased sedentism (Custer 1986:108). The quality of data from the Mid-Drainage Zone, where the project area is located, is described by Custer as "fair" (Custer 1986:131). In the Mid-Drainage Zone, macro-band base camps would be expected at low terraces of major drainages at stream confluences, and at saltwater-freshwater interface of the marsh (Custer 1986:131). Mortuary sites would be located central to several different micro-base camps (Custer 1986:131).

Micro-band base camps of the Woodland I period tend to be located close to unique and seasonably variable resources (Custer 1986:106). It is difficult to quantify these types of sites however, because they are more ephemeral in nature and have not been extensively studied (Custer 1986:106). In the Mid-Drainage Zone, macro-base camps would be expected at the confluences of low order streams and tidal marshes (Custer 1986:131). In association with macro-base camps, procurement sites would be located in the precise location of the desired resource. In the Mid-Drainage Zone, procurement sites would be expected along minor and ephemeral drainages adjacent to poorly drained woodlands and on small ridges and knolls (Custer 1986:131).

Sites of the Woodland II period show increased sedentism and a breakdown of the trade networks developed in the previous era (Custer 1986:136). Sites would be expected, however, in the same locations as in the Woodland I period (Custer 1986:161).

Combining the data summarized above, Custer has quantified the probability of finding significant sites throughout Delaware. The project area lies in Zone II, which has a Medium/High Significance Probability, Medium Data Quality and a Medium/Low number of known sites (Custer 1986:198). The probability for Woodland Period sites would be higher than for those from the Paleo-Indian and Archaic eras. The probability of locating the latter two types of sites, while low, cannot be ruled out entirely.

The location of the project area near Meeting House Branch and St. Jones River would have made it favorable for prehistoric occupation. The extent of the impacts to the prehistoric resources by the construction of houses and of the gas plant would have been considerable. Additional impacts would have occurred at the time of the demolition of the gas plant. There is a low probability for intact prehistoric remains.

C. Regional Historical Background

This section relates generally to the history of Dover and environs, which is not intended to be specific to the site itself. In accordance with the *Delaware Comprehensive Historic Preservation Plan*, this section has been divided into five chronological periods: Exploration and Frontier Settlement (1630-1730 +/-), Intensified and Durable Occupation (1730-1770 +/-), Early Industrialization (1770-1830 +/-), Industrialization and Early Urbanization (1830-1880 +/-), and Urbanization and Early Suburbanization (1880-1940 +/-) (Ames *et al.* 1989; DeCunzo and Catts 1990).

Exploration and Frontier Settlement (1630-1730 +/-). Early exploration and settlement of the Delaware Bay and River was initiated by the Dutch and Swedish. The Dutch West India Company founded the first short-lived settlement, Swanendael, in 1631 near the mouth of the Delaware Bay with the intention of making a profit from whaling and growing grain and tobacco. A year after its founding, the settlement's all-male population was annihilated by Sickoneysink Indians (DeCunzo and Catts 1990:29).

The New Sweden Company established Fort Christina at the confluence of the Brandywine and Christiana Creeks in 1638. Soon after, Swedish and Finnish farmers and traders settled in the vicinity. The Dutch disputed the Swedish claim to this land and built Fort Casimir, further south, in order to limit Swedish trade on the Delaware River. Disputes between the Swedish and Dutch continued until 1654, when the Dutch defeated the Swedish and took control of both forts. The Dutch then established a settlement at Whorekil (Lewes) in order to stop English migration into the region from Maryland (DeCunzo and Catts 1990:30).

In 1664, however, the English under Sir Robert Carr, a representative the Duke of York, defeated the Dutch and took control of the colony. The Dutch, Swedish and Finnish settlers in Delaware were permitted to remain after swearing allegiance to the English (DeCunzo and Catts 1990:30).

In 1670, William Penn was appointed proprietor of all the land from Whorekil (where a court was established) to New Castle (previously known as Fort Casimir). When Penn chose Philadelphia as the seat of the Pennsylvania Colony in 1682, that city became the economic and political focus for the Delaware region (or the Lower Counties) (DeCunzo and Catts 1990:33).

During this period, settlement along the Delaware coast increased and expanded inland along the navigable waterways. In 1680, St. Jones County (later called Kent County) was established, and there were about 26 families living along St. Jones Creek [River] at that time (Sammack and Wilson 1967:11). The settlement pattern in this region was characterized by dispersed farms located along navigable waterways. Waterfront locations provided fertile land and the best means of transportation (DeCunzo and Catts 1990:35). Travel along inland routes was arduous and time-consuming. Although a road from Lewes to Philadelphia existed at this time, it was not officially established as the King's Highway until 1752.

In 1680, 65 settlers petitioned Governor Edmund Andros for a courthouse at St. Jones Creek [River] because they found the journey to Whorekil [Lewes] difficult (Sammack and Wilson 1967:11). Three years later, William Penn issued a warrant for surveying the town of Dover at the headwaters of St. Jones Creek. Penn's warrant included instructions for laying out the town streets perpendicular to the road from Lewes to Philadelphia (King's Highway). In 1694 or 1695, the County purchased 200 acres of land from William Southebee for the town of Dover. This land was a portion of an 800-acre tract known as *Brother's Portion* (Sammack and Wilson 1967:11). A courthouse was built soon after the tract was purchased. It was not until 1717, however, that the streets, squares, and lots of the town were platted. At this time a reservation was made for Meeting House Square, at the corner of Governor's Avenue and North Street, upon which the project area is located. In 1722, a new Court House was built on higher ground and the vicinity came to be known as The Green (Fox and Heite 1977).

Intensified and Durable Occupation (1730-1770 +/-). By the middle of the eighteenth century, Dover served as an economic and political center for Kent County. Thus its population included magistrates, lawyers, clergymen, physicians and merchants. The County's population in 1743 included 1,132 heads of household (Sammack and Wilson 1967:11). In 1741, the Assembly passed a bill for laying out a market square and establishing and regulating a market in Dover. Most of the early settlers had grown tobacco, rye, and barley. These crops, however, were replaced by wheat during this period because it was more profitable (DeCunzo and Catts 1990:32; Blagg 1980:103). Kent County's wheat and flour was brought into Dover and then transported to Philadelphia, from where it was exported to Europe, the West Indies and other North American colonies (DeCunzo and Catts 1990:33). A description of Dover by the French Comte de Segur in 1778 provides a complimentary view of the town's early development:

> the first American town to which fortune had conducted me. Its appearance struck me; it was surrounded with thick woods because there, as in other parts of the thirteen states, the population was still scattered over an immense territory, a small portion of which was cultivated. All the houses in Dover offered a simple but elegant appearance. They were built of wood and painted with different colors. This variety in their aspect, the neatness which distinguished them, the bright and polished knockers of the doors, seemed all to announce the order and activity, the intelligence and prosperity of the inhabitants (quoted in Blagg 1980:103).

Early Industrialization (1770-1830 +/-). During the Revolutionary War, Delaware suffered economic loss rather than physical destruction because it was not the site of any major battles. British warships disrupted maritime trade and attacked coastal towns. During the winter of 1777 to 1778, the British occupied Wilmington and seized Delaware's President McKinly as well as the state records (Sammack and Wilson 1967:21). The state legislature, fearful of meeting in New Castle, chose Dover as the new capital. In 1783, a peace treaty was signed with Great Britain and in 1787, Delaware became the first state to ratify the Federal Constitution (Sammack and

Wilson 1967:21).

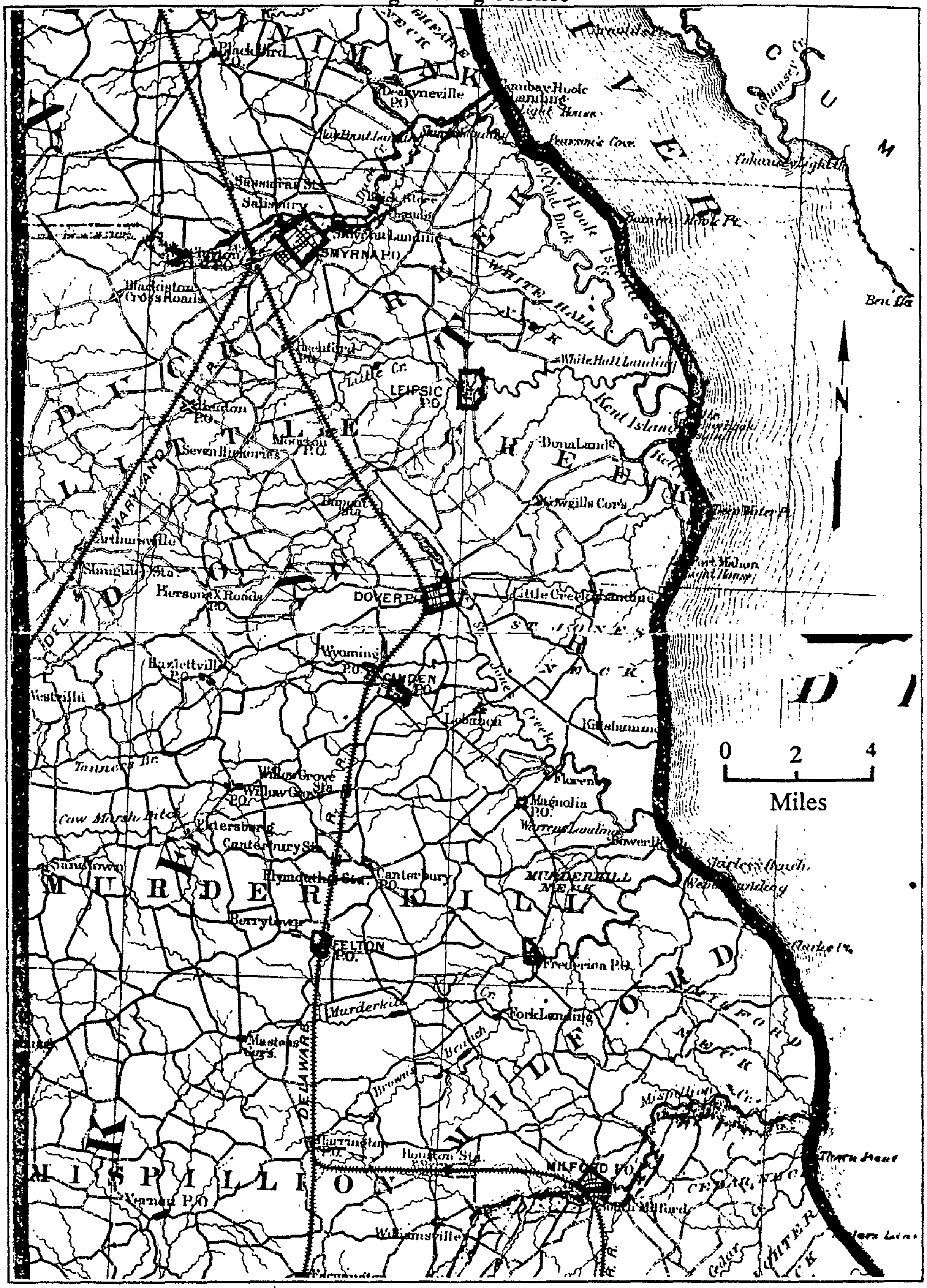
In 1785, Dover's population had reached 600. An account made by W. Winterbotham shows that the town had weathered the war years well and that trade with Philadelphia remained strong.

> Dover consists of about 100 houses, principally of brick. Four streets intersect each other at right angles whose incidences form a spacious parade, on the east side of which is an elegant statehouse of brick. The town has a lively appearance and thrives on a considerable trade with Philadelphia. Wheat is the principal article of export. The landing is five or six miles from the town (quoted in Sammack and Wilson 1967:31).

By the turn of the century, however, the economy of the region declined. Not only were wheat prices down, but there was also a decline in agricultural products because traditional farming practices had diminished the productivity of the land. During the first half of the nineteenth century, there was a movement to encourage the widespread use of fertilizers, better farming practices, and agricultural diversification.

Industrialization and Early Urbanization (1830-1880 +/-). The greatest boost to the region's economy was the construction of the Philadelphia, Wilmington and Baltimore Railroad in 1839. New Castle County was the first to benefit, but when the line was expanded in 1856 as the Delaware Railroad, the southern counties did also. Prior to the rail service, parts of western Kent County were characterized by small farmsteads because transportation was difficult. The construction of the Delaware Railroad, west of the watershed, provided better access to these agricultural lands. Agricultural production in Kent County expanded beyond `the growing of grain, which did not require immediate transport to markets, to include the more lucrative fruits and vegetables. Rail transportation provided the rapid shipment necessary for perishables and permitted the growth of wider markets for all agricultural products. During the 1830s to 1870s, peaches dominated the fruit market. Kent County's income from orchard products increased dramatically from $10,000 in 1850 to $500,000 in 1870 (Hoffecker 1977:45-47). The downstate region was transformed: agricultural and industrial production expanded, new towns grew, and beach tourism developed *(Figure 3)*.

Serving as a station on the Delaware Railroad line, Dover became the center of an expanding commercial and industrial economy in the region. Dover also became a food processing center. Numerous canneries were established, as were factories for making food processing equipment. Packing houses and distilleries also proliferated. The construction of the Dover Gas Works during the late 1850s provided illumination for Dover's growing manufacturing concerns, as well as for domestic use (Blagg 1980:104). By the end of the nineteenth century, a number of industries in Dover burned coal as part of their manufacturing process or for heating. These included the Dover Machine Works, E.L. Jones & Company, M.A. Hartnett Woodworking and the Dover Lumber and Milling Company.



Source: Pomeroy and Beers, 1868

Figure 3
Railroad in 1868

Dover Gas Light

The outbreak of the Civil War caused social rather than economic problems for Delawareans because they were divided on the issue of slavery. Southern regions of the state, particularly areas with ties to the Chesapeake, tended to support the Confederacy, while northern regions supported the Union. Sussex County contained more than half of the state's slaves. According to the 1860 Census, Kent County contained 200 slaves and 7,271 free blacks (Sammack and Wilson 1967:35).

Urbanization and Early Suburbanization (1880-1940 +/-). Industrial and urban development continued in Dover through the late nineteenth and twentieth centuries. The successful manufacturing businesses attracted new workers, who contributed to the slow but steady increase in the town's population, which reached 3,329 in 1900. The town's boundaries were extended to the north and west to include Bradford city and the Belle Mary Farm subdivision (Sammack and Wilson 1967:39). During the early years of the twentieth century, electricity came to be used extensively; a sewer system was installed; and the city streets were paved. The increased availability of automobiles and trucks and the construction of the duPont highway (beginning in 1916) established Wilmington's dominance as a commercial center (Heite 1990a:7). In 1939, the International Latex Corporation was opened in Dover and became one of the area's largest employers. The Dover Air Force Base was constructed prior to World War II. The growth and urbanization of Dover increased during the 1950s and 1960s because the Air Force Base was reactivated; the International Latex Corporation was expanded; and General Foods opened its offices there in 1963 (Sammack and Wilson 1967:49).

1. Historic Period Research Design

The significance of the former manufactured gas plant to the history of Dover and the State of Delaware is best evaluated using the *State Preservation Plans* (Ames *et al.* 1989; Custer 1984; Herman *et al.* 1989; DeCunzo and Catts 1990). Research conducted as part of this study was directed by the state plans and the known or anticipated resources at the site.

The growth and evolution of the former manufactured gas plant corresponds with two historic periods: *Industrialization and Early Urbanization* (1830-1880+/-) and *Urbanization and Early Suburbanization* (1880-1940+/-). During the *Industrialization and Early Urbanization* period, Dover became the center of an expanding regional commercial and industrial economy as a result of the Delaware Railroad, the growth of the food processing and canning industry, and crop diversification in the surrounding region. During the *Urbanization and Early Suburbanization* period, further improvements in transportation and technology as well as new employment opportunities (e.g., Dover Air Force Base, International Latex Corporation), increased suburbanization and slowly shifted the region's economy away from agriculture.

The former manufactured gas plant was most important during the last half of the *Industrialization and Early Urbanization* period and first half of the *Urbanization and Early Suburbanization* period. The former manufactured gas plant further corresponds to the historic theme of "manufacturing" and subtheme of "chemical production and processing." At this level, the plant's growth and evolution in response to rapid industrial progress and alternative lighting and power sources is significant.

A property type, which may be located in the project area, is the 1840s house tenanted by the free African-American John Harris. This house fits into the historic period of *Industrialization and Early Urbanization* and the historic theme of "settlement patterns and demographic change."

Another property type, in existence between 1875 and 1919, in the project area was a single-unit house at the corner of North and New Streets. This dwelling falls into the historic periods of *Industrialization and Early Urbanization* and *Urbanization and Early Suburbanization*. It further fits into the historic theme of "settlement patterns and demographic change."

An additional property type in the project area was the double two-story house. Five of these houses were located on the southern portion of the project area, three along Bank Lane and two along New Street. The first of these houses was constructed on Bank Lane adjacent to the Presbyterian Church cemetery by 1886, the remaining four were constructed by 1899. All of these houses were demolished by 1919. This property type corresponds with the historic period of *Urbanization and Early Suburbanization* and the historic theme of "settlement patterns and demographic change."

IV. PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS IN DOVER

There have been few archaeological investigations within the city of Dover, Delaware. The most recent archaeological investigation was conducted by Edward F. Heite (1990b) within the Dover Green Historic District on two lots located on the square bounded by The Green, State Street, Governors Avenue, and Water Street. The investigation revealed features, including a carriage house and other outbuildings, wells, garden plots and dog burials, associated with daily life through three centuries of Dover's history.

Several archaeological investigations have been conducted by the State Preservation Office in the vicinity of The Green. During the fall of 1991, a study was conducted at the site of the new Biggs Museum, located in the area bounded by The Green, North, Federal and Court Streets, which uncovered the remains of a late nineteenth-century and early twentieth-century structure as well as a trash pit containing artifacts dating to the first quarter of the eighteenth-century. An earlier investigation was conducted at the Murphy House, #417 S. State Street, after excavation for a power line revealed an eighteenth-century trash pit. The artifacts found are most likely associated with the Eagle Tavern. Finally, another collection of eighteenth century artifacts were collected from a trash pit found behind the Sykes Building, #45 The Green, prior to construction for the Kent County Courthouse Annex. Some of these artifacts were probably associated with the Washington Tavern and other domestic artifacts associated with the Sykes House (Fithian, personal communication:1991; Guerrant, personal communication: 1992).

An additional study was conducted at the Old State House, The Green, by Cara Wise when the building was being restored to its original appearance. These excavations revealed footings and builder's trenches associated with two earlier structures: a 1740s county office building and the 1722 court house (Wise 1978).

Finally, an archaeological investigation conducted by Heite (1990a) at the Collins, Geddes Cannery Site in Lebanon, Delaware, provides information regarding the evolution of can design and technology, cannery workforce and the significance of the canning industry in Kent County and Delaware.

Though few in number, these studies provide evidence for the existence of intact archaeological resources within Dover. Analysis of these resources has contributed valuable information regarding the social, economic and technological development in Dover, Kent County and Delaware. Therefore, intact archaeological resources may exist within the project area which are associated with the former Dover Gas Light plant. Domestic structures could contribute additional data regarding manufacturing and trade, domestic economy, landscape, social groups and identity during the nineteenth century.

V. HISTORICAL OVERVIEW OF THE PROJECT AREA

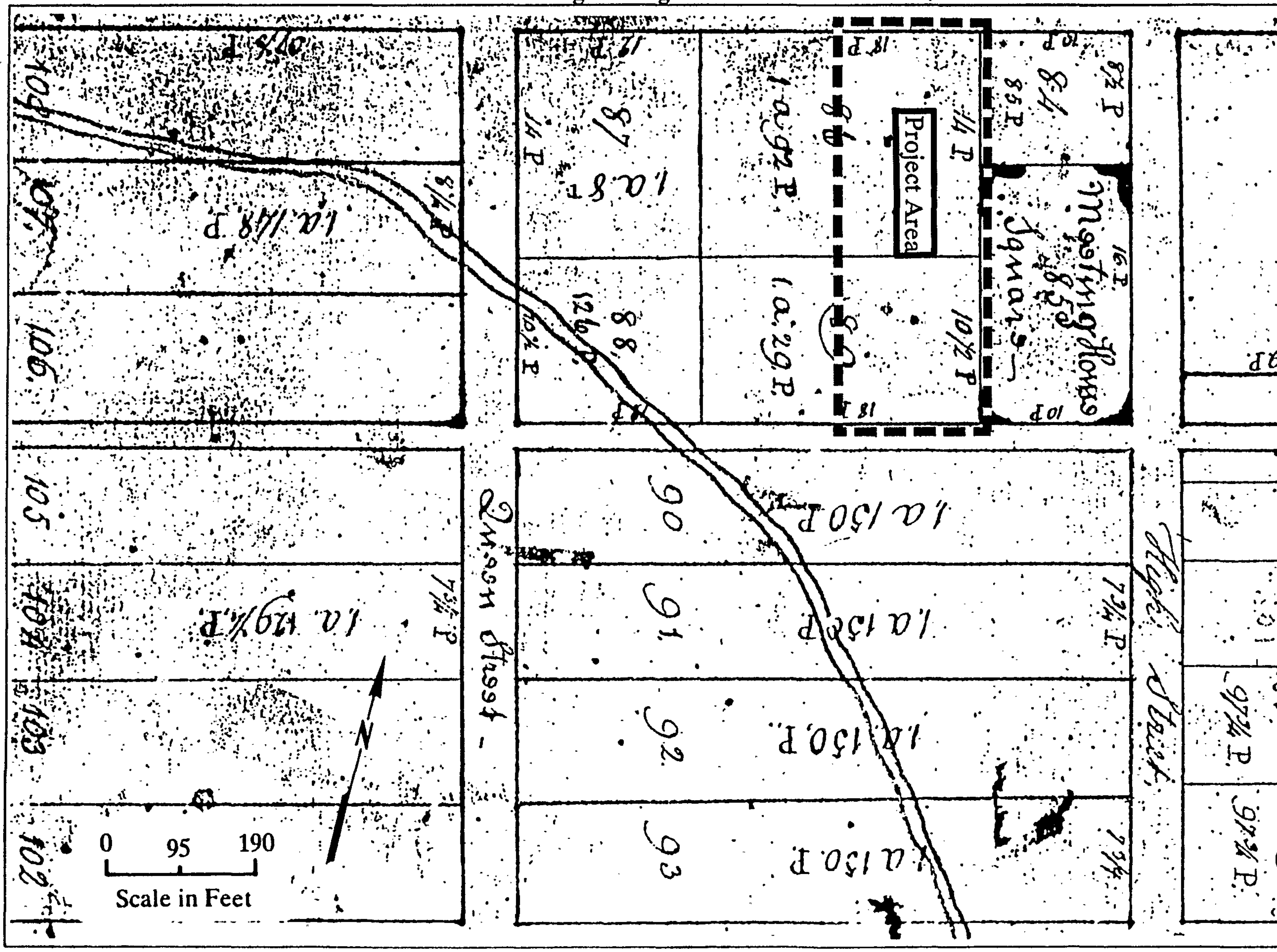
A. 1729-1859

According to a plat made of Dover in 1768, the project area property was originally located in lots numbered 86 and 89 on the square bounded by North Street, High Street (now Governor's Avenue), Queen Street, and Court Square Alley (now Bank Lane) (*Figure 4*). On February 12, 1729, the Dover Commissioners, Benjamin Shurmer and Richard Richardson, sold lot 86 (approximately one acre in size) and a lot fronting on the north side of Courthouse Square (currently known as the Green) to Thomas Tarrant. (Kent County Deed Book I:217). It is not clear whether Tarrant constructed anything on lot 86. His dwelling house was located on the lot fronting on Courthouse Square (the Green)(Kent County Deed Book M:95).

Tarrant's will, written in August and probated September 1740, refers to his three heirs, his wife Mary and two children, Susannah and Thomas. Tarrant requested that his real estate be sold after his death in order to cover his debts. The remainder was to be divided into equal thirds among his heirs (Kent County Will Book I:22-23). In May 1741, Tarrant's widow, Mary, and her new husband, Arthur Ussher, sold both of Tarrant's lots to Cornelius Empson, a shopkeeper (Kent County Deed Book M:95). In August of the same year, Empson purchased lots 87, 88, and 89 on the same square from the Dover Commissioners (Kent County Deed Book M:131).

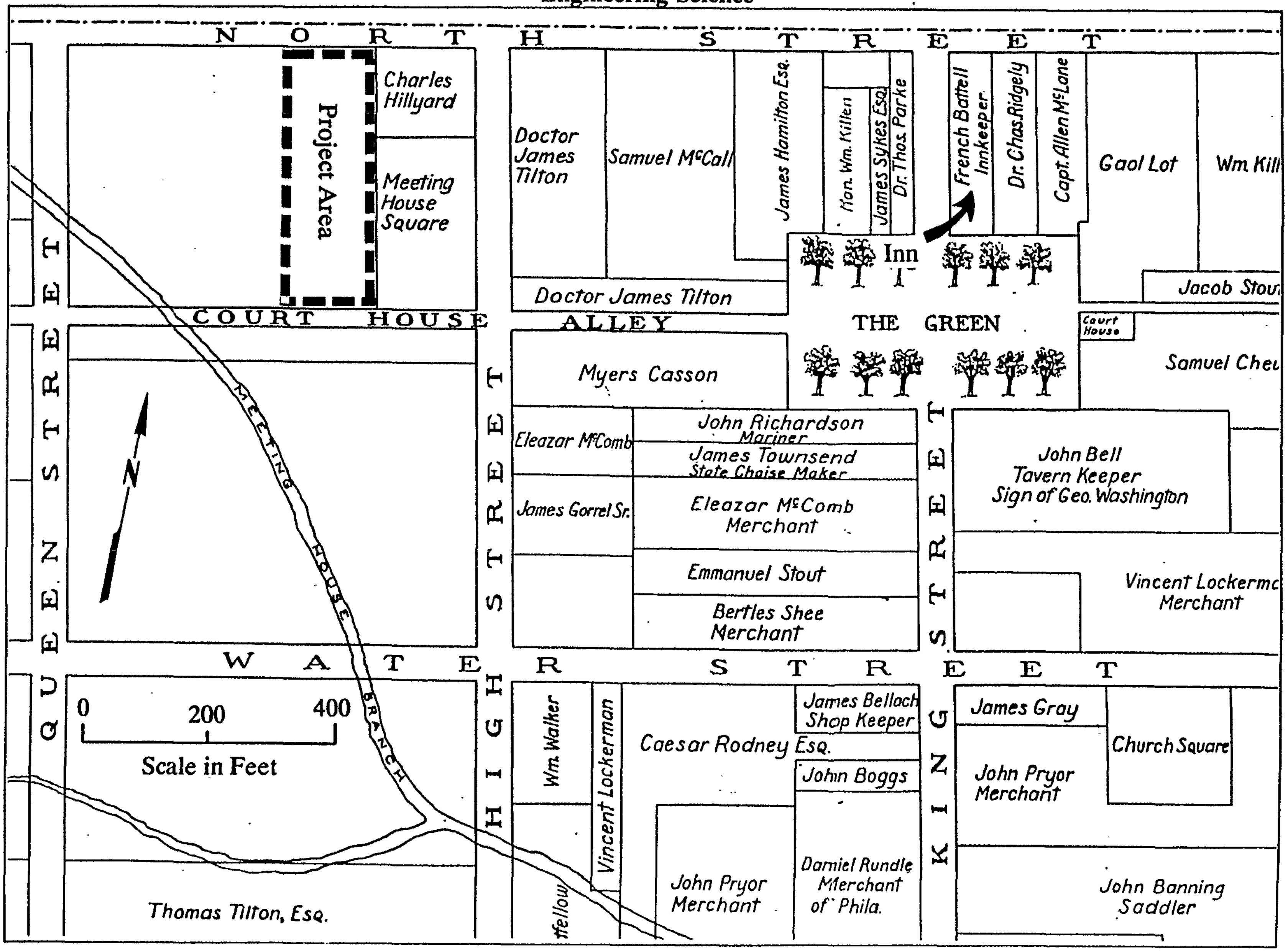
Empson made his will in December 1751, referring to himself as a merchant. It is probable that his wife had died because he only mentions his five children in his will. To his two sons, Charles and William, he bequeathed the lot containing his dwelling house on Courthouse Square. To his three daughters, Hannah, Sarah and Elizabeth, he devised his lots "lying near of the Presbyterian Meeting House." He requested that the remainder of his personal estate be divided equally among his children. He named his daughter Hannah Empson and his daughter Elizabeth's husband, French Battle (also Battell), as executors of his will, which was probated in February 1752 (Kent County Will Book K:53).

The project area property thus descended to the daughters of Cornelius Empson, Elizabeth Battell and Sarah and Hannah Empson. Elizabeth Battell and her husband French, who was a colonel, remained in Dover. They appear to have had four sons, John, James, French and Cornelius. According to Scharf, French Battell initially rented, then purchased a lot with an inn on Court House Square in 1774 (*Figure 5*). He died in about 1781, and bequeathed the property to his widow Elizabeth (Scharf 1888:1047). The Dover Archives have a collection of private accounts kept by Battell, from 1752 to 1781 which reveal that he was also a general merchant, tavern keeper, and saddle and harness maker (Battell, Private Accounts Collection). By November 1792, Elizabeth had also died and John Battell was named administrator of the estate (Kent County Will Book N:32-33). By March 1794, John had died and administration of the property was passed to French and Cornelius Battell (Kent County Will Book N:80).



Source: Rodney, 1768

Figure 4
Project Area in 1768



Source: deValinger Jr., 1936

Dover Gas Light

Figure 5
Project Area & Location of French Battell's Inn Late 18th Century

AR308457

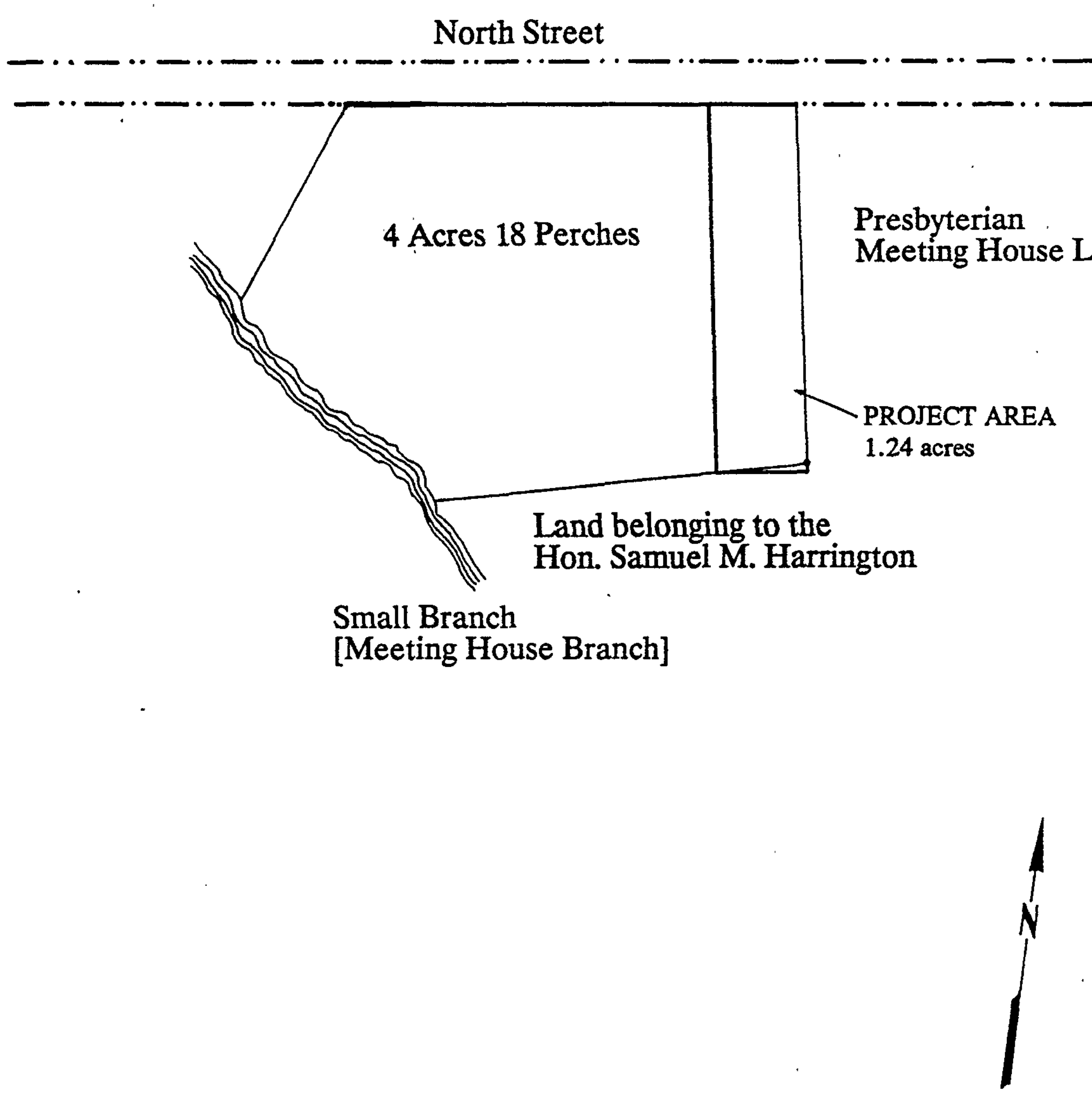
In August 1794, Hannah Empson made her will. She remained unmarried and bequeathed all her real and personal estate to her nephew Cornelius Battell. (Kent County Will Book N:128). Cornelius Battell died November 7, 1820 at the age of 47 years (Dover Archives Tombstone Records).

At his death, the property descended to Catharine Bishop, who may have been his daughter. While her maiden name could not be confirmed for this study, a witness at her marriage was Peregrine Battell, whose father was French Battell, Esquire of Philadelphia (Dover Archives Marriage and Death Records). In February 1829, Catharine Bishop, a widow, died intestate, leaving three heirs. She had been married twice. Her first husband was Dr. Arthur Johns, with whom she had two children, Jacob F. Johns and Elizabeth Johns. Her second husband was Risdon M. Bishop, with whom she had a daughter, Catharine Bishop (Kent County Orphans Court Book M:80). In March 1832, the court decided it was in the best interest of her heirs to sell her property and divide the profits equally among them. The court records describe the project area as lot #10, "a lot of ground adjoining the Presbyterian Meeting House containing 5 acres." In the records for the March Term 1834, there is a deed and plat of her property near the Presbyterian Meeting house. The property was sold for $350 to Samuel Van Burkelow (also Van Burcala). This plat describes the property as containing four acres (Kent County Orphans Court Book N:72) (*Figure 6*). The 1841 tax assessment shows Van Burkelow as the owner of two houses and lots. He occupied the one valued at $600. The other was occupied by a tenant named J. Harris, a black man, and was valued at $500 (Kent County Tax Assessments). This house was located on the 4-acre property adjacent to the meeting house.

In January 1843, Van Burkelow's heirs sold the 4-acre property to Caleb Sipple and Robert O. Pennewill, merchants. The lot is described as "having a small house in the tenance of John Harris, negro" (Kent County Deed Book R-3:168). John Harris is listed in the 1830 and 1840 census records. He was a free black man living with a free black woman and four children (Delaware Census Records). There is no later record of Harris in the census or mortality records.

In June of 1847, Sipple sold his interest in this property with "a small house thereon erected" to Pennewill (Kent County Deed Book V-3:221). The 1850 census lists Robert O. Pennewill as a merchant owning real estate valued at $20,000. By 1853, Pennewill had died and his widow, Elizabeth C., and his two sons, Caleb G. and John C., were his only heirs-at-law. Elizabeth released her dower right, clearing the right to his estate to Pennewill's sons. His sons "made an amicable partition" of his estate and Caleb granted the 4-acre parcel and dwelling to John.

This is the last deed reference made to the dwelling on the 4-acre property. The 1856 tax assessments list Pennewill as the owner of 4 acres near Dover in the tenure of himself and "with a small house in the tenure of Caleb Spearman." According to the 1850 census, Spearman lived with the family of a blacksmith named Isaac Crouch. Spearman was listed as a 30-year-old black laborer. The 1856 assessments also show that Pennewill rented a blacksmith shop to I. L. Crouch, presumably the same man that Spearman was living with. Pennewill retained most of this original 4-acre parcel until



Source: Kent County Orphans Court N:72

Dover Gas Light

Figure 6
Property Sold to
Van Burkelow in 1834

1874. A review of tax assessments after 1856 reveal nothing further regarding the property and the house. Although Pennewill is listed as the owner of several small frame houses, there is no information regarding their location.

On October 11, 1859, John C. Pennewill granted 12,000 square feet of this 4-acre parcel to Daniel Trump. This small lot was located on the south side of North Street and the west side of the Presbyterian Church lot (Kent County Deed Book Q-4:345). There was no mention of the small dwelling.

B. 1859 - 1985

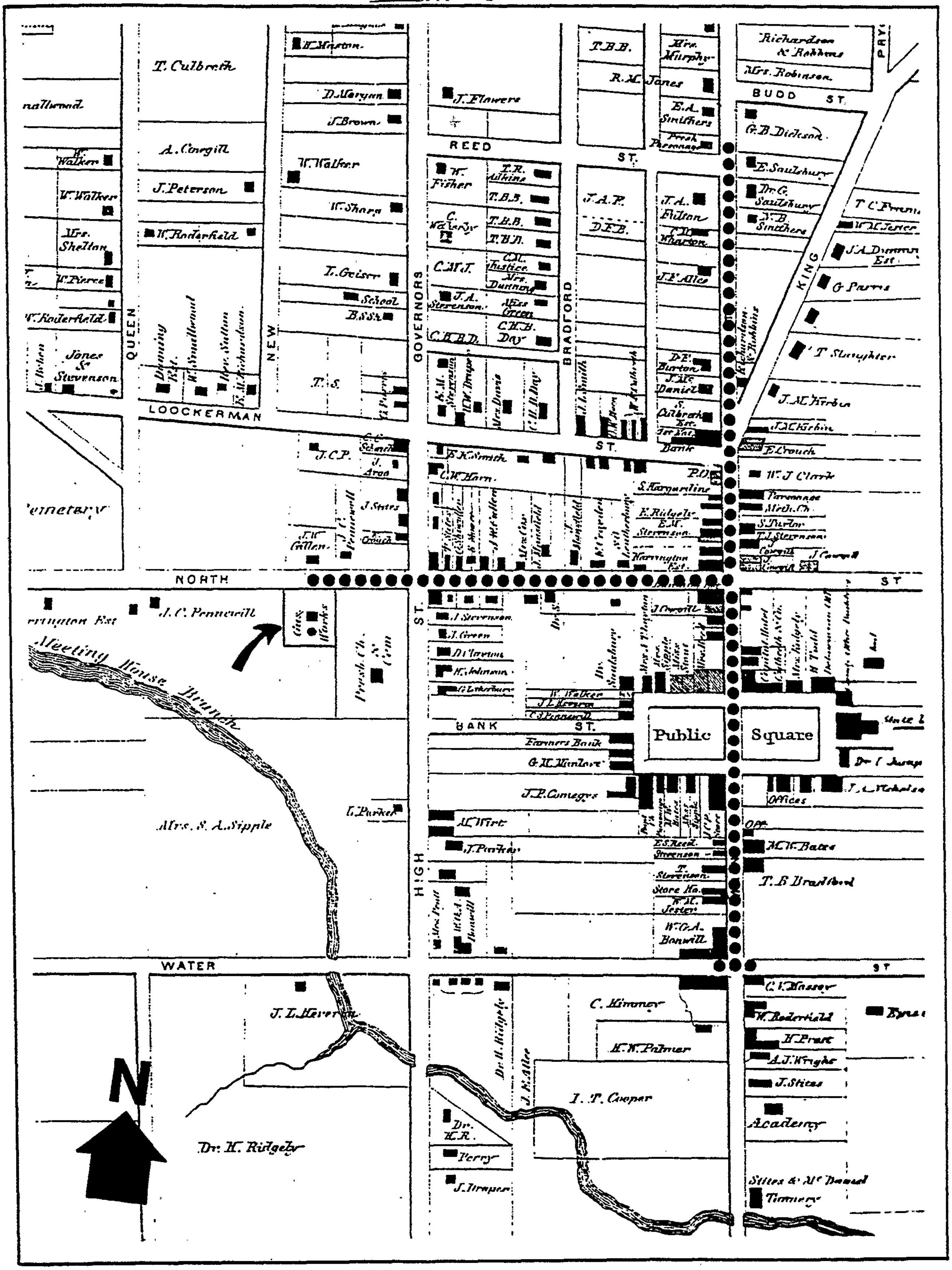
It was on this 12,000-square-foot parcel, however, that gas production began in 1859. The introduction of gas in Dover was mentioned favorably by the local press several months prior to the opening of the gas works.

> Gas - We are to have gas, in our houses in our workshops, in our streets. Not the kind that voluble individuals indulge in occasionally in the aforesaid places, but illuminating gas, that will light up our long winter evenings in a manner truly refreshing to our fluid-and-candle-bedimmed eyesights. Already our eyes feel relieved at the prospect of gaslight. We can imagine ourselves walking the streets of Dover on a cloudy, rainy night without a stick to feel the curbstone to keep us on the side walk. Trees, posts, and boxes will have no terrors for us when the reign of gas begins - great institution! We hail with joy the laying of the corner-brick of the gas-factory. We rejoice exceedingly that it is being introduced into our churches. We hail its advent everywhere. May it never blow out or be blown out by naughty boys, for great is the fragrance thereof when the tap is turned (*The Delawarean*, July 9, 1859).

The deed of sale, dated October 11, 1859, transferring the property from Pennewill to Trump mentions neither the gas works nor the price. It is unclear what sort of an agreement Pennewill and Trump had entered into regarding the construction of the works and the sale of the land. However, construction of the gas works had already commenced by July 1859.

A local newspaper describes in part the construction of the works: "Workmen are now engaged in covering the bottom of the reservoir with a thick coating of hydraulic cement, iron main pipes are laid along the streets preparatory to inhumation, and fixtures being put up in the houses of prospective consumers" (*The Delawarean*, July 30, 1859). It is likely that "reservoir" refers to a gasholder.

The gas works was designed to manufacture gas from resin. The gas mains were laid in a T-shaped configuration, extending from the gas works east to Main Street (State Street), south through the public square to Water Street. A pipeline also extended north along Main Street from North Street to Reed Street (*Figure 7*). Some of mains dating from this period continued in operation until the gas works closed in the late 1940s.



Source: Pomeroy & Beers, 1868
An Atlas of the State of Delaware

Dover Gas Light

Figure 7
Location of Dover Gas Works and Pipeline System in 1868

AR308461

The gas works were completed on October 8, 1859. The event was celebrated with fireworks sponsored by the youth of Dover (*The Delawarean*, October 8, 1859). Operation of the plant began one week later (*The Delawarean*, October 15, 1859). An article in *The Delawarean* indicates that the plant did not immediately supply gas for street lighting:

> More Light - Now that the gas-works have got into operation, we hope our Town Commissioners will see the propriety of lighting the dark and dismal streets of Dover with gas during the long winter nights. We already have iron lamp posts erected, and a trifling expense will fit them for gas. The public want light - let them have it (*The Delawarean*, October 29, 1859).

The article suggests that the City of Dover had not initially contracted for street lighting. It is possible that the plant supplied gas to residences and other buildings at this time. In any case, the streets were illuminated in December of 1859 (*The Delawarean*, December 3, 1859).

The assessed value of the gas works property in 1860 was $3,000. It was assessed at the same amount from 1861 through 1863 and in 1865 (Kent County Tax Assessments). There was no assessment available for 1864. There is some discrepancy in the described size of the land: the deed of sale lists it as 12,000 square feet whereas the assessments list it as one acre - over three times as large. It is probable that the assessments include land purchased by Charles M. Trump independently of the gas works site.

Difficulties appear to have been encountered in the operation of the gas plant. In 1862, the gas was sold at $4 per 1,000 cubic feet. In contrast, the Wilmington Coal Gas Company charged $3 per 1,000 cubic feet (*American Gas Light Journal* 1862:198-99). This price difference could be due to population differences of these two towns; the population of Dover was only 2,000 whereas the population of Wilmington was 20,000 (*American Gas Light Journal* 1862:198-99). The impracticality of supplying a smaller, less industrialized town may have caused the higher price. In addition, the cost of resin increased dramatically during the Civil War years, necessitating the use of less expensive coal oil, the term by which kerosene was originally known, and wood in the gas manufacturing process (Scharf 1888:1074). It is also possible that there were mechanical difficulties. In any case, between the years 1860 and 1866, the price increased from $4 to $8 per 1,000 cubic feet of gas and the plant eventually went out of business (*The Delawarean*, April 27, 1867).

In the October Term of 1863, a suit was prosecuted against Daniel Trump by six of the seven heirs of John C. Pennewill: Joseph P. Comegzs and his wife, Margaret A.; Thomas B. Bradford and his wife, Lucinda H.; Samuel M. Harrington and his wife, Mary L.; Isaac Baker and his wife, Sarah A.; and Caleb S. Pennewill,all of Dover Hundred, and George P. Fisher and his wife, Ann Eliza, of Washington, D.C. (Kent County Superior Court Records). These heirs brought suit against Trump because he was indebted to the family for $6,000. It is possible that Trump's debt was related to problems with the gas works. The judge of the Superior Court convicted Trump and executed a writ of *Levari Facias*, which directed the Sheriff to sell the property and the buildings erected on it in order to recover the sum which Trump owed (Kent County Superior Court Papers). On November 2, 1863, the Sheriff sold the property to Comegz *et al.* The property was described as a 12,000-square-foot parcel including:

> . . . all the buildings, gas works, gas holders, metres or meters, furnaces, benches and all appurtenances of any and every kind thereon erected or being a part of said gas works, and the gas mains, service pipes, metres or meters, and other appurtenances and machinery now laid or placed in, through, or under the streets of the town, or in and under the pavements and houses thereof and connected with the said gas works as means of lighting or appertaining to the lighting of the said town or any house, or building, or church therein with illuminating gas, ways, waters and watercourses, casement, profits, commodities, and appurtenances therewith belonging and rents, issues and profits thereof (Kent County Deed Book W-4:122).

The Kent County Superior Court Execution Docket shows that Trump paid his debt and on November 5, 1863 Comegz *et al.* sold the property back to him for $1,700 (Kent County Deed Book V-4:482).

A notice in *The Delawarean* stated that the gas works were for sale (*The Delawarean*, September 8, 1866). On February 5, 1867, Daniel Trump and his wife Mary M. sold the property and gas works to Alden B. Richardson and James Robbins for $5,000 (Kent County Deed Book C-5:330). A. B. Richardson and James Robbins had opened a tin and stove store in the early 1850s. Their business expanded to include canning and in 1863 they purchased a building at the corner of State and King Streets to house their canning factory.

An April, 1867 newspaper article discusses the intentions of Richardson and Robbins in purchasing the works, their rehabilitation of the plant and the expected cost to the public. It also explains that the works had been closed for all of 1866 after being abandoned by the Trumps.

> "Gas - The enjoyment of brilliant light from gas, manufactured at the Dover gas works, prompts us to make honorable mention of the enterprising firm who, with commendable public spirit revived, we might say resurrected, the business of making gas in our town. Our streets being without light for nearly the whole of last year, and all the fixtures in stores and residences out of use for the want of gas, Messrs Richardson and Robbins thought that as gas would be a great convenience to them in their fruit canning establishment and no disadvantage to the public, they would interest themselves in the matter. They bought the works abandoned by Messrs Trump, refitted them in the most complete manner, and now furnish rich gas, that has no superior anywhere, at a cost of about $6 the 1000 feet, which is equivalent to $3 the standard. The Messrs Trump, the former owners of the work, sold gas at $4 the standard in 1860; they afterwards advanced the price to $6, and finally to $8 the standard. The enhanced price of labor and material since the year 1860 makes the difference in price the more remarkable, but an explanation is found in the economical and skillful manner in which the works are at present conducted and also to the fact that Messrs R. and R. do not expect to make a living out of the business. They wanted gas to light their own establishment, and are

> content to receive from the public such compensation as will reimburse them for the manufacture, and pay the interest on their investment. Greater liberality could not be expected from any source, and we trust that our townspeople will evince their appreciation of the endeavors of these gentlemen to serve them by using gas in preference to any other light, it being the best, the safest, and cleanest, if not the cheapest in the end, to be obtained. And it will be well enough to suggest to those interested, that the larger the number of consumers the less in proportion will be the price, the works being able to supply six times the amount at the present used (*The Delawarean*, April 27, 1867).

The 1869 and 1872 tax assessments value all the property owned jointly by Richardson and Robbins at $8,000, which included both the cannery and gas works. An individual assessment of each property was not available (Kent County Tax Assessments). These assessments would have included the recent conversion of the plant from a resin to a coal gas manufactory, which had been accomplished by 1869. By 1870, Richardson and Robbins had constructed 5000 feet of additional piping with more installed at later dates. However, most of the buildings associated with the Dover gas works were not constructed until the early 1880s (Sanborn 1885). The original retort house, constructed in the late 1860s, was the only building remaining on the site dating to this early period of coal gasification (Sanborn 1897).

On January 4, 1875, Richardson and Robbins insured a "new one and half story frame dwelling house situated on the south side of North Street on a lot known as the Gas House lot" with the Kent County Mutual Insurance Company. The building was further described as being 28 by 14 feet with a shingle roof. The building's estimated value was $600 and insured valued was $400. In addition, the insurance form stated that "ashes were kept fifty feet from the building, the pump in gas house about seventy five feet from the buildings, distance to the nearest building about sixty feet. The house was warmed by stoves, the pipes of which were well secured in brick flues" (Kent County Mutual Insurance Policy Number 4842).

The insurance policy does not indicate if the new house was a reconstruction of the house mentioned in the 1843 deed of sale from Van Burkelow to Robert O. Pennewill. It is not known if the earlier house was actually on the gas works property. Richardson's and Robbins' intent in building the house is not entirely clear. It may have been a business venture unrelated to the plant or a residence for a worker or workers at the plant. The land on which the house was constructed, however, was always considered to be part of the gas works property.

The 1875 insurance record does state that the new house was occupied by a black man named Peter Moore (Kent County Mutual Insurance, Loose Manuscripts, Policy #4842), but does not indicate whether he worked at the plant at that time. A Peter Moore did work at the plant from 1881 to 1883. The 1870 U.S. census lists a Peter Moore as a 39-year-old black laborer. Residing in his household were Martha Moore, a 29-year-old housekeeper, and three children, Henrietta, aged 10; Isaac, aged 4; and Elizabeth, aged 8 (U.S. Census 1870). The census does not list where Peter Moore worked. This could be the same Peter Moore who resided in the house insured in 1875. This census, however, predates the construction of the house by five years.

Moore may or may not have worked at the plant at this time.

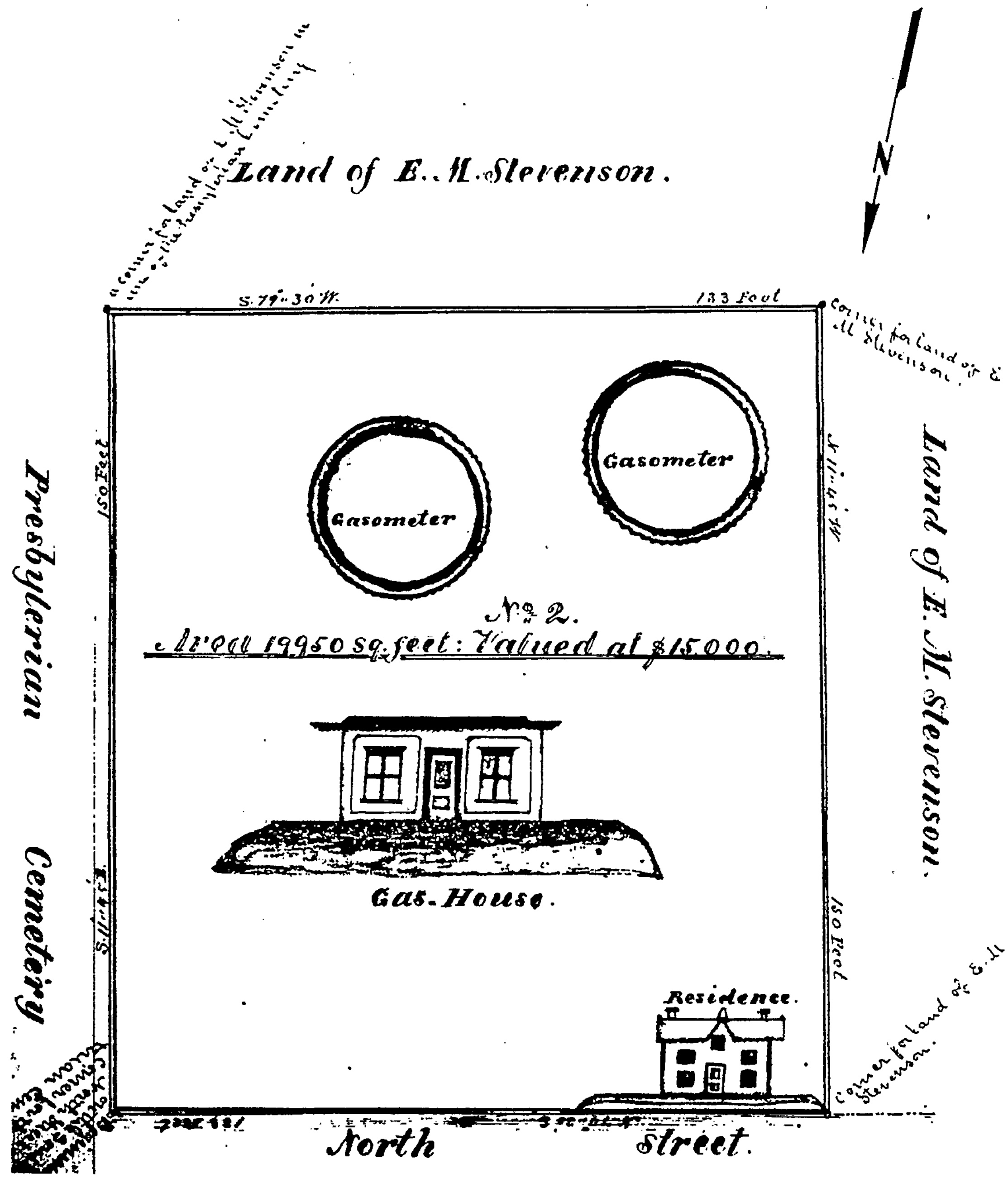
James W. Robbins died from a sudden illness on June 27, 1876 (*The Delawarean* July 1, 1876). He made his will the day he died, leaving $60,000 to various friends and relatives and bequeathing the remainder of his estate to his 11-year-old niece, Ella Robbins. A series of entries in Chancery Petition Dockets (Vol. F:98-112) outlines the deposition of his estate. It was established that Alden B. Richardson and Ella Robbins were now joint owners of the cannery and the gas plant. The chancery docket gives the locations of the properties but does not describe specific structures on them. The court ordered that these properties be surveyed and split into equal halves. At this time a plat of the gas plant was made *(Figure 8)*.

The plat indicates that the value of the property was $15,000. Its size was 19,950 square feet. This size was noted in the docket as being correct, in contrast to earlier documents which gave the size as 12,000 square feet. The plat also shows the location of the structures on the property. Two gasometers were located on the south side of the property, shown in plan view as large, circular structures. The gas-house occupied the central portion of the property, shown in elevation as a one-story structure with a flat roof and two windows flanking a central doorway.

A residence was included as part of the gas plant property. The illustration on the plat is that of 2 1/2 story dwelling, with an attic window in the central cross-gable and a central doorway flanked by one window on either side for both the first and second floors. The plat also shows internal end chimneys. The insurance records describe the new house built in 1875 as 1-1/2 stories tall with a perimeter measuring 28 by 14 feet. This 1-1/2 story height seems more accurate than the plat rendering. Renderings are often inaccurate. In this case, the scale of the door in comparison with the windows would not allow for the building to be 2-1/2 stories.

The surveyors who made the plat reported to the court that it was not possible to split the properties without detriment to both owners. At the request of the representatives of both parties, the gas plant property including the house, and cannery were put up for sale. Alden B. Richardson purchased them both on January 30, 1877. He paid the assessed value of $15,000 for the gas plant and deed of sale for the gas works property was recorded in June 1878 (Kent County Deed Book Y-5:490). The price paid by Richardson shows that the value of the gas plant property increased by $10,000 between 1867 (date of purchase by Richardson and Robbins) and 1876.

The gas works is listed in the Manufacturer's Schedule for Delaware in the 1880 census. At that time the amount of capital invested in the gas works was $18,000. The plant employed no more than three people at any one time. Two of these were males above 16 years of age. An ordinary work day was 12 hours. Wages for a skilled mechanic was two dollars per day; unskilled labor received $1.50 per day. The total amount of wages paid out during the year was $1,130. The value of materials was $2,500. The value of the product was $4,500 (U.S. Census, Manufacturer's Schedule 1880).



Source: Chancery Petition Docket, Vol.F

Dover Gas Light

Figure 8
Project Area in 1876

In July 1881, Richardson and his wife Lucy M. sold the gas works to the newly incorporated Dover Gas Light Company for $21,000 (Kent County Deed Book F-6:388). In addition, Richardson agreed to procure and lay, at his own expense within six months of the sale date, the necessary pipe as follows: a 6-inch iron main east on North Street to Governor's Avenue; thence north on Governor's Avenue to Loockerman and east on Loockerman Street to State Street - a 4-inch iron main (Kent County Deed Book F-6:388).

The Dover Gas Light Company had been incorporated March 21, 1881 (Laws of Delaware, 1879-1881, Chapter 635:762). The incorporation is recorded in the Enrolled Bills of the Dover General Assembly (1881 Vol. 2:89-95). Members of the board of directors were: Alden B. Richardson, Henry A. Richardson, Caleb J. Pennewill, William G. Wilson, and George V. Massey. Richardson apparently felt that incorporating the company would be more beneficial than running it privately. The purpose of the company was to supply the town of Dover and private individuals with artificial light from gas or electricity. The bill authorized the company to enter upon any street or building for the restoration, installation and inspection of pipe and wires. Such repairs and installations were to be done as quickly and with as little damage as possible. During the process, private citizens were to be kept from danger and accident. The company had the right to purchase land and build any structures necessary to carry out their business. The capital stock of the company was $50,000 and was to be divided into 2000 shares of $25 each. A penalty of not less than $50 was to be imposed on any individual who tapped the gas mains or electrical wires, or turned on the gas or electricity after the company had shut it off. The fine for the destruction or damage to the company's property was not to exceed $200 (Enrolled Bills 1881 Vol 2:89-95). The incorporation paper indicates that the Dover Gas Light Company may have intended to use electricity for lighting. There is no evidence, however, that this plan was carried through.

Three cash books and a ledger of the Dover Gas Light Company dating from July 7, 1881 to February 14, 1890 were located at the Delaware Historical Society. These records show that Peter Moore, previously mentioned, worked at the plant until April 1883. He received $10 weekly. His place of residence and duties are not specified. Moore's assistant, Isaiah Pratis, received $6 weekly. Also in the company's employ was S. B. Hancock, who carted coal and sometimes fire clay, and was paid about $16 every month. Hancock is listed as a carter in the 1882 and 1891 city directories (Ferris 1882:113; Costa 1890:1160). Another employee, George Jarrell, took meter readings and periodically helped work on the mains, pipes and odd jobs at the plant and was paid on a monthly basis. G.P. Jarrell is listed as a plumber and gas fitter in the 1882 directory, as a plumber in the 1884 directory and as a gas fitter in the 1891 directory (Ferris 1882:113; Polk 1884:88; Costa 1890:127). Various others performed blacksmith and construction work at the plant. In May, 1883, two new employees, Burton and John Wilson, replaced Peter Moore and Isaiah Pratis. Their weekly salaries were $12 and $8 respectively. They worked until at least February, 1890, at which time their combined weekly salary was $22 (Dover Gas Light Company Cash and Ledger Books).

The books also show payments made by the company to the Philadelphia, Wilmington and Baltimore Railroad for freight charges; to the American Meter Company; to the Westmoreland Coal Company and the Phoenix Manufacturing Company; and the Gloucester Iron Works. The company also subscribed to the *American Gas Light Journal*, which cost $2 per year (Dover Gas Light Company Cash and Ledger Books).

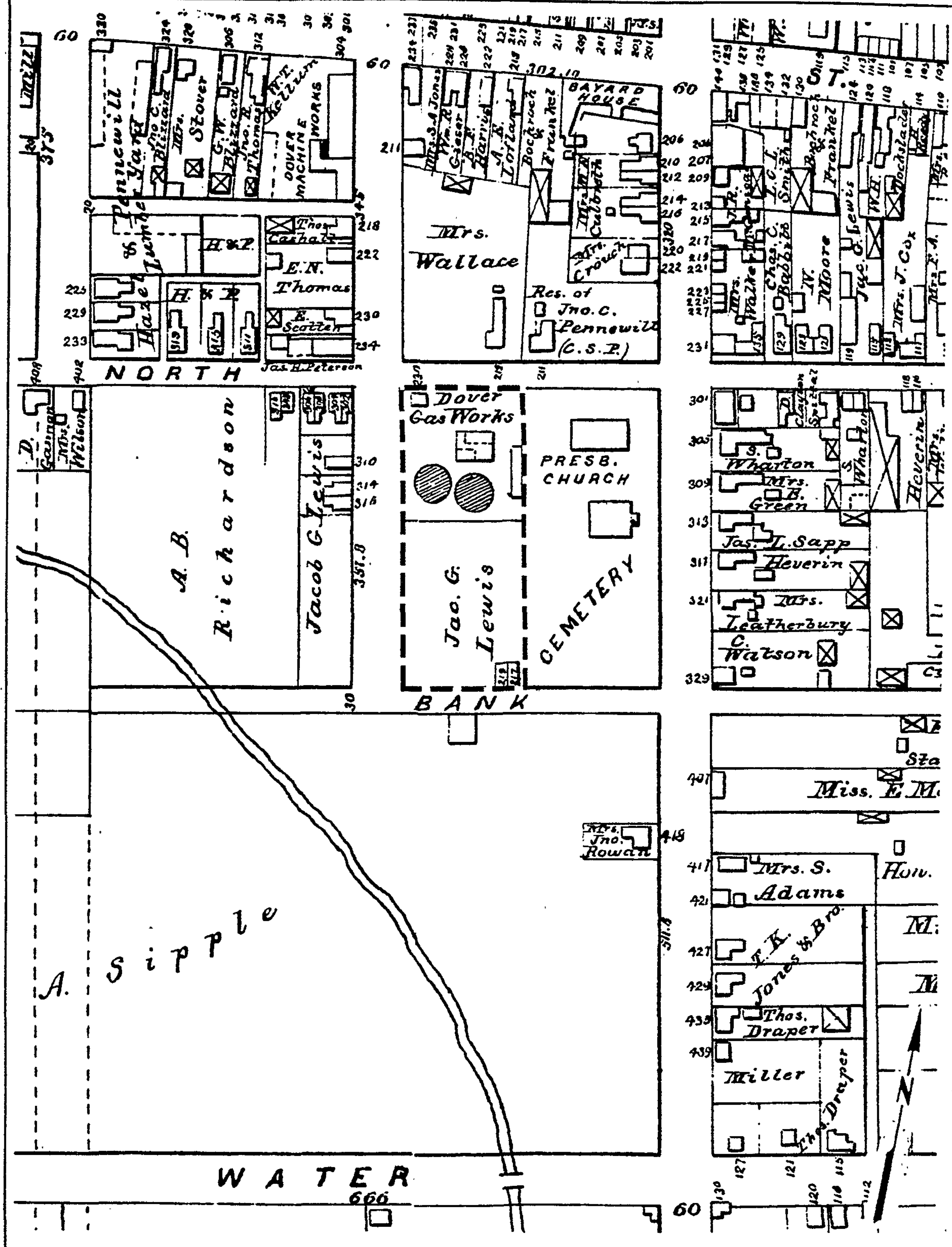
Assessments for the years 1890 and 1891 value the Dover Gas Light Company at $6,666 (Kent County Assessments, East Dover Hundred: 1890, 1891). In 1896, the company was assessed at $10,000 (Kent County Assessment, East Dover Hundred: 1896).

Between 1897 and 1919, the facility expanded in capacity. This was made possible by additional purchases of land to the south of the plant made by the Dover Gas Light Company. The property to the south of the plant to Bank Lane was retained by John C. Pennewill until March 1874 and was part of the original 4-acre parcel. In 1874, Pennewill and his wife, Virginia sold a little over two acres of this parcel to Edwin M. Stevenson for $700 (Kent County Deed Book Q-5:214). Stevenson was not listed in the tax assessments in 1876 or 1880. In 1881 and 1882, Stevenson sold a little over an acre of this property to Jacob G. Lewis (Kent County Deed Book H-6:335). In November 1884, Lewis sold a small lot adjoining the southern boundary of the "gas house lot" to the Dover Gas Light Company. He sold another small parcel adjoining the first to the Company in April 1888 (Kent County Deed Books Q-6:284; Z-6:461).

Between 1884 and 1886, Lewis built a 1-1/2 story house on Bank Lane with a rental value of $60 and a total value of $500 (East Dover Hundred Tax Assessments). This house appears on the 1887 Roe map (*Figure 9*). Later tax assessments for Lewis are not as informative and detailed. In 1896, he is listed as the owner of a slaughter house on E. North Street and an ice house on Washington Street. However, by 1897, Lewis had constructed additional houses on this property. After his death in 1899, Lewis' property was subdivided and sold to pay his debts. At this time, his property at the corner of Bank Lane and New Street contained "five double two-story frame dwelling houses with outbuildings and other improvements"(Kent County Orphans Court Book L-2:416). A plat of this property showing the five houses on five separate lots was included in the court proceedings (*Figure 10*).

In March 1900, Lewis' executor, William B. Stewart, sold the five lots to Franklin Temple. Temple sold these lots to William Uhlig in December of that year for $1,500 (Kent County Deed Book K-8:181). The 1900 census lists all the residents on Bank Lane as being white working class families. The residents of these houses included a 29-year-old carpenter Harry Cummings and his wife, Annie; and Wilson Honey, a 17-year-old general laborer, his wife, Sallie, and their one-year-old daughter, Ethel (1900 Delaware Census).

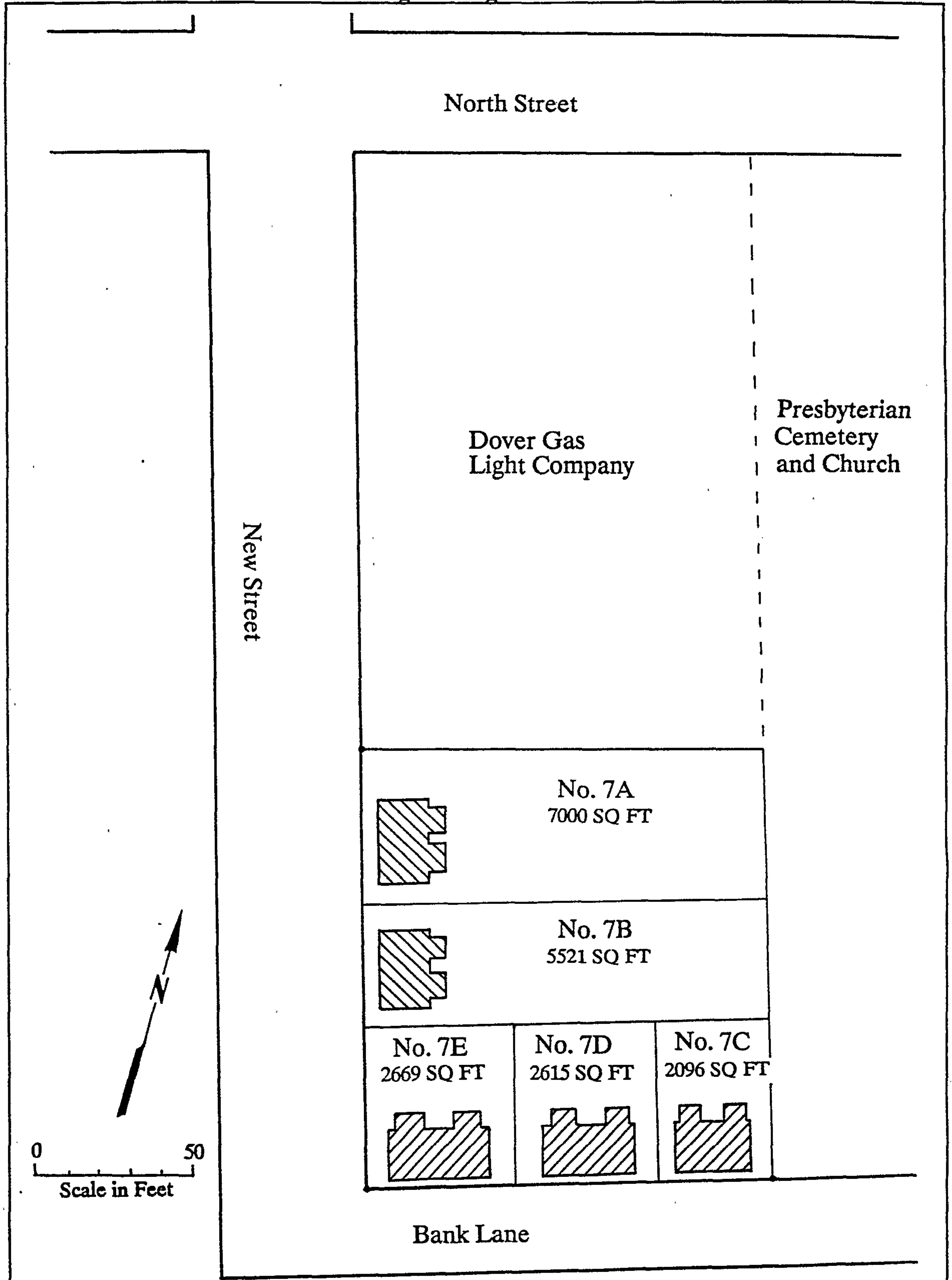
Uhlig and his wife, Augusta, sold the five lots to the Dover Gas Light Company in April 1910 for $2,700 (Kent County Deed Book X-9:125). They reserved the rights to the rents and profits and to the buildings and their foundations until February 1911. Between 1911 and 1919, these houses were torn down by the Gas Light Company.



Source: Roe

Dover Gas Light

Figure 9
Project Area in 1887



Source: *Kent County Orphans Court Plot Book* 6:94

Dover Gas Light

Figure 10
Plan of Jacob G. Lewis' Property, 1902

By 1919, the processing building was enlarged, and the smaller gasholders replaced by ones with larger capacity, including a 20,000- and a 100,000-cubic-foot gasholder. Oil tanks replaced the coal storage bins, and the site was more intensively utilized. The dwelling on the northwest corner of the property was removed sometime during this period.

In 1935, the passage of the Public Utility Holding Company Act, intended to simplify the corporate structures within the utility industry through consolidation and mergers, resulted in the reorganization of the General Gas and Electric Corporation ("General"). In addition to the Dover Gas Light Company, General also owned the Eastern Shore Public Service Company which provided gas to Cambridge, Maryland and electricity elsewhere on the peninsula. In 1942, General sold its interest in Dover Gas Light to Harrison and Company, a Philadelphia investment banking firm which already owned the Hagerstown Gas Company in Hagerstown, Maryland. The general partners in the Harrison firm, Charles Harrison III, David B. Sharp, Jr., and Robert E. Daffron, Jr. had been instrumental in the formation of Chesapeake Utilities Corporation (Dover Gas Works File).

On December 30, 1949, The Dover Gas Light plant was sold to the State of Delaware for $15,000 and administered by the Public Archives Commission (Kent County Deed Book U-18:366). At that time the property measured 47,024 square feet or 1.08 acres.

By 1950, all of the Dover Gas Light Company manufactured gas plant facilities had been demolished and removed from the site for disposal, with the exception of the original retort house. This building was used by the Delaware State Museum to store heavy exhibits until the mid-1980s. In 1955, the remainder of the property was leased to the Dover Parking Authority for use as a municipal parking lot. In 1966, the Johnson Building of the museum was constructed on the southwest corner of the site. The storage building, which was the only remaining gas works building, was damaged in a fire on July 1, 1982, and the building was demolished and removed from the site several years later (Dover Gas Works File).

C. Other Gas Companies in Delaware

The Dover Gas Light Company was not the first gas plant in Delaware. At least two other gas plants, in Wilmington, and New Castle, preceded it. A comparison of the production of these companies can be made using a chart compiled for the EPA in 1985 (Eng 1985:B-52). The chart presents production information from *Brown's Directory of American Gas Companies* for every ten years from 1890 to 1950 *(Table 1)*.

In 1890 and 1900, the Dover Gas Light Company produced five million cubic feet of gas per year (Eng 1985:B-52). This number jumped to 14 million in 1910, at which time the plant was producing water-gas (A description of the manufacturing process will be found in Section VI). The plant steadily increased production to 49 million cubic feet in 1940. By 1950 it supplied only natural gas (Eng 1985:B-52).

Another plant was located in New Castle, Delaware. The New Castle Gas Company was established in 1857 (Boyd 1859-69:305) This company operated on a somewhat smaller scale than the Dover plant. It produced two to four million cubic feet of gas in 1890, 1900 and 1910 (Eng 1985:B-52).

Table 1
Delaware Town Gas Manufacturing Production
(1890 - 1950)*

			Gas Production Rate				
City	**Year**	**Gas Type**	**Coal**	**Water**	**Oil**	**Total**	**Process**
Dover	1890	Coal	5			5	
	1900	Coal gas	5			5	
	1910	Water		14		14	Lowe
	1920	Water		21		21	Lowe
	1930	Water		36		36	Lowe
	1940	Water		49		49	Lowe
New Castle	1890	Coal gas	2			2	
	1900	Coal gas	4			4	
	1910	Coal gas	4			4	
Wilmington	1890	Coal gas	120			120	
	1900	Coal gas, oil gas	153	51		204	
	1910	Water		370		370	Lowe
	1920	Water		540		540	Lowe
	1930	Water		1,200		1,200	Lowe

* Adapted from Eng 1985, Appendix B, Table B-1

Information was not available for the New Castle plant after 1910 (Eng 1985:B-52). The smaller quantity of gas production is probably due to smaller population of these areas. In 1899, the New Castle company served 200 customers (Brown 1899:15). In comparison, the Dover Gas Light Company served 400 customers in 1899 (Brown 1899:15).

Manufactured gas was introduced in Wilmington in 1833 by the Wilmington Gas Company (Scharf 1888:668). Initially, this company supplied gas made from resin for 80 cents per 100 cubic feet and then reduced the price to 70 cents per 100 cubic feet. In 1848, a small boy lit a jet of gas issuing from a gasometer and the works blew up. They were rebuilt, however, with $3,000 of insurance money. In 1851 this company was purchased by the newly formed Wilmington Coal Gas Company (Scharf 1888:668)

The Wilmington Coal Gas Company was by far the largest producer of gas in Delaware. This company produced 120 million cubic feet of gas in 1890, 24 times as much as was produced in Dover (Eng 1985:B-52). The difference is in part due to population. The Wilmington company served 6764 customers whereas the Dover company served only 400 in 1899 (Brown 1899:15). Another key factor was the greater industrialization of the city of Wilmington. Production had increased to 370 million cubic feet by 1910, at which time water-gas was produced (Eng 1985:B-52). By 1930, production was at 1,200 million cubic feet per year. By 1940, the company purchased rather than manufactured gas (Eng 1985:B-52).

VI. GAS LIGHTING AND MANUFACTURE

A. History of Gas Lighting

Gas light for public and private illumination was almost exclusively an urban phenomenon. The growth of cities during the eighteenth and nineteenth centuries created a demand for street lighting, which was initially met by oil or candle lamps and which were the responsibility of private citizens. However, by 1800, street lighting in the larger cities was becoming increasingly a municipal responsibility (Passer 1953:12). The streets of London were first lighted by manufactured gas in 1813 (Rotsch 1967:223). The first gas company in the United States was organized in Baltimore in 1816, but by 1835, larger cities such as New York, Brooklyn, Boston, and New Orleans all had gas companies (Passer 1953:12). The technology of producing gas from coal had been invented in the early eighteenth century in Europe. However, the impetus for its use in the United States stemmed from the War of 1812, when the textile mills in New England began using gas light in order to operate mills past dusk, thus increasing daily production. Subsequently, manufactured gas was quickly adopted for small businesses located near the mills.

Although gas light is often associated with street and home lighting, its primary customer was industry. Manufacturing concerns needed illumination not only to extend working hours but also to adequately light building interiors. The Dover gas works were constructed soon after the completion of the Delaware Railroad in the mid-1850s. The timing of the railroad was fortuitous, allowing Dover factories to take advantage of both new distribution methods as well as the availability of gas lights, which allowed them to increase production.

Gas had little competition throughout the nineteenth century until the widespread availability of electricity. Production of natural gas began during the Civil War, but because of distribution problems, it was used only near the gas fields of the South and Southwest until the 1920s (Rotsch 1967:223). By the 1850s, when the first efficient meters were introduced, the business of providing widespread gas light service became commonplace. By 1875, there were more than 400 gas companies in the United States, most of which were located in larger cities (Passer 1953:12). Gas was usually produced from a central station where economies of scale resulted in lower unit prices and thus increased demand. However, gas works were also found in smaller cities and towns although rarely in rural areas. Only with technological advances which lowered production costs could a small urban area sustain a gas company. Small town businesses and manufacturing facilities often had to operate their own gas works in the absence of a market sizeable enough to attract an independent operator. By 1900, gas works could be found in towns with populations as low as 5,000.

The advent of electric lighting by the 1880s, both arc lighting and incandescent, had serious repercussions for the gas light industry, although electricity only surpassed gas for lighting after the turn of the twentieth century. Arc lighting held advantages over gas for lighting large areas, such as streets. This, however, was not especially deleterious to the gas companies because street lighting was largely unprofitable for the gas companies. In many cities, street lighting was undertaken solely as a prerequisite to obtaining a city franchise. Electric arc lighting for streets was first used in Cleveland in 1879 with portions of New York and Washington following in the early 1880s (Rotsch 1967: 224). In Dover, the Light and Water Plant provided electricity for street lighting in 1900 (Sammack and Wilson 1967:41).

Incandescent lighting, however, was particularly threatening to the gas industry. By the 1890s, interior illumination, the area in which electric lighting was particularly competitive, accounted for 90% of all gas revenues (Passer 1953:196). In 1882, the first steam-powered central generating plant, the Pearl Street Station, was installed in New York by the Edison Electric Company to serve 500 customers. However, it was the demonstrations at the Columbian Exposition, held in Chicago in 1893, which greatly promoted a widespread acceptance of electric lighting. By the early years of the twentieth century, production and distribution of electricity had been perfected which gradually, but effectively, diminished the hegemony once held by the gas industry.

Similar threats to the gas industry appeared in the 1860s with the introduction of kerosene lamps (also called coal oil lamps because it was first distilled from coal) following the discovery of oil in Pennsylvania in 1859, and the possibilities of large-scale petroleum production and refining. As a result of this new energy source, new techniques of gas production appeared by the 1870s. In particular, the production of water-gas, a simpler process in which steam was forced through hot coke, reduced the costs of production. The introduction of gas mantles in the 1890s to improve the quality of light allowed the gas companies to compete with incandescent electricity in the area of interior lighting. Nonetheless, improvements in product quality and price reductions did little but delay the impending dominance of electricity for lighting (Rae 1967:347).

One response to these changes in the industry was to diversify, and thereby increase, the market for gas. Gas stoves and gas heating both became points of promotion during the 1880s although the process was a slow one. Manufactured gas, while extensively used for lighting during the nineteenth century, had held virtually no market for heating. Gas companies also began providing electricity to customers. By the mid-1880s, gas companies in a number of cities began offering electric lighting service. By 1887, approximately 40 gas companies supplied electric lighting. By 1889, the number had risen to 266, or roughly 25% of all gas companies in the United States. Ten years later, 40% of all gas companies supplied electric lighting (Passer 1953:199). In addition to the lighting market, gas companies undoubtedly decided to move into electricity production because of changing manufacturing needs. The use of electrical power to operate machinery and to heat and light factories increased thirty-fold during the 1890s, or roughly fifteen times the increase in total power used by industry (Passer 1953:343). Ironically, at the turn of the century, large factories with their own mechanical power plants were less apt to use electric motors for automated processes. Small factories, however, where mechanical power generation was less efficient, were a ready market for electric motors.

In the twentieth century, manufactured gas increasingly found its share of the utilities market compromised. In addition to developments in electrical production which allowed for broad distribution patterns, new techniques in welding, developed in the late 1920s, solved the pipeline problems which had hampered the widespread use of natural gas. By the mid-1930s, it was possible to transport gas economically for a thousand miles. With a heat content twice that of coal gas and costing less, natural gas began to be used for house heating, central power stations, and industry. The mass marketing of this inexpensive and abundant fuel by the post-World War II era effectively ended the manufactured gas industry (Netschert 1967:246).

B. General Description Of Gas Manufacturing Processes and Equipment

The two primary processes by which gas was manufactured at the former Dover Gas Light Site were the coal carbonization and carbureted water-gas processes. The manufacture of gas from coal oil and resin were also processes used at the former Dover Gas Light site. These processes, however, are similar to the coal carbonization process. Coal carbonization consisted of heating bituminous coal in a sealed chamber (a retort), causing the distillation of gas from the coal and the formation of coke. The resulting gas was purified and distributed while the coke was removed from the retort and used as fuel or sold. The carbureted water-gas process used coal, steam and various oil products to produce a combustible product gas. Steam was fed through a bed of incandescent coke, producing a gas containing hydrogen and carbon monoxide. This gas, known as blue gas or water gas, then passed through two chambers containing hot firebrick, where oil was sprayed into the gas and cracked into gaseous hydrocarbons and tar (Harkins *et al.* 1988:ES-1).

Both types of gas manufacturing processes needed production and storage facilities. The primary production facility for the coal carbonization process was the retort house. It contained the retort and facilities for an exhauster, condenser, purifier, and metering equipment. In larger works these may have been housed separately. The primary production facility in the carbureted water-gas process included a room housing the generator, carburetor and superheater, a purifying room (later the purifying structure was located outside) and a boiler room. The storage facilities for both included structures to house the fuel necessary for the gasification process (i.e., coal shed and oil tanks) and the by-products (i.e., gas holders and tar tanks). Many plants also included a foreman's house, because the foreman could be needed anytime night or day. Gas works were usually located near railroad stations or freight depots in order to limit long distance cartage of coal. The Dover Gas works were located about three blocks from the railroad.

The following is a general description of the two processes for manufacturing gas and the types of equipment used. The lack of building plans and photographs of the interiors of the former Dover Gas Light Company buildings make it impossible to establish the actual types of equipment and procedures used.

1. Coal Carbonization Process and Equipment

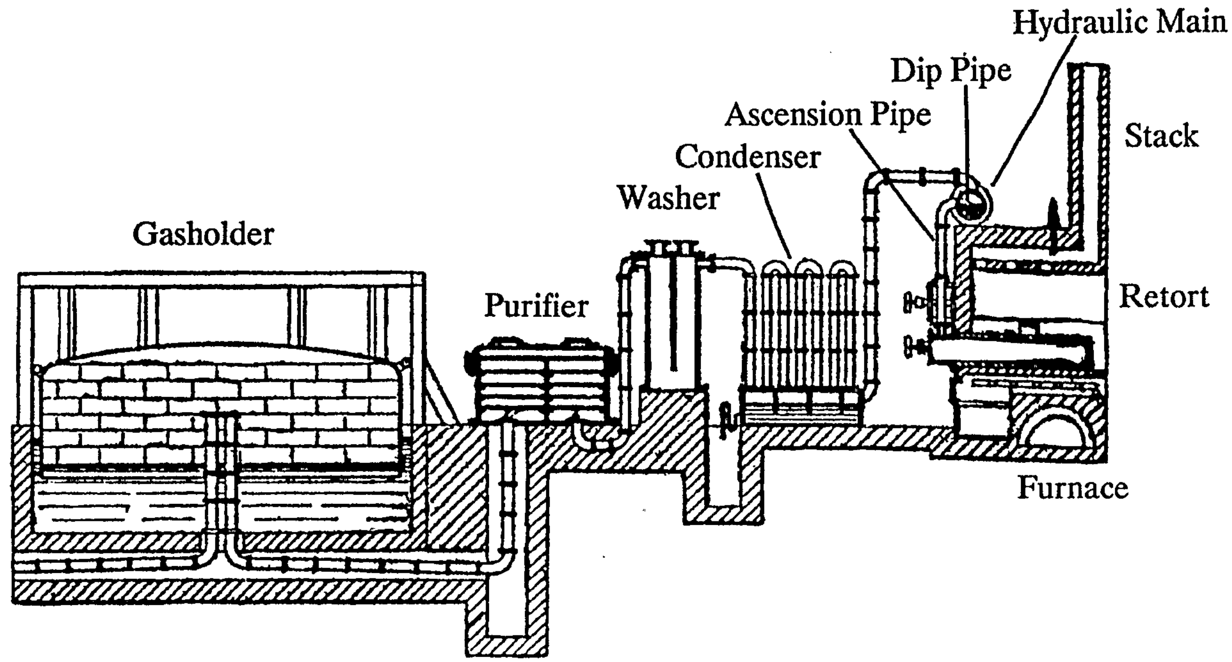
The Retort House: In small towns, all the coal carbonization equipment was located in a simply designed and constructed retort house. "The outside walls were calculated to give the greatest security with the least possible material." They were built of brick, with a wrought-iron roof and a wooden ventilator (monitored, or louvered, roof). Many did not have a coke-cellar, so charges were drawn out into a wheel barrow and spread in the yard to cool (Park 1880).

The equipment in the retort house was designed for the three stages in the coal carbonization process: distillation, condensation, and purification (*Figure 11*). Distillation of coal occurred through carbonization, or the heating in the refractory vessel the retort until all volatile elements such as gas, tar, and ammonia were eliminated, leaving only the coke. Coal was selected for its high content of volatile matter and low ash content. The distillation process took about eight hours. In small works, coal was loaded into the retorts by hand using a scoop or shovel. Larger plants had mechanical retort-stokers.

The most common retorts were long, semi-cylindrical D-shaped or cylindrical vessels which were sealed at one end. They were at least 21 x 14 inches wide and 8 or 8-1/2 feet long internally, making it easier to load large charges of coal and to draw out the coke. The retorts were fired prior to the addition of the coal. Iron retorts were fired to temperatures of 1470 degrees Fahrenheit. After 1853, clay was available, and retorts made of fireclay could be fired to temperatures ranging from 2010 to 2370 degrees Fahrenheit (Wilson 1974:35). Clay retorts were considered better than iron because they could be fired to hotter temperatures and retained their heat longer. (Silica retorts were not available until the 1920s). In addition, clay retorts lasted longer, 2.5 years, compared to the 6- to 8-month life of cast-iron retorts (Harkins et al. 1988:12; Park 1880:904).

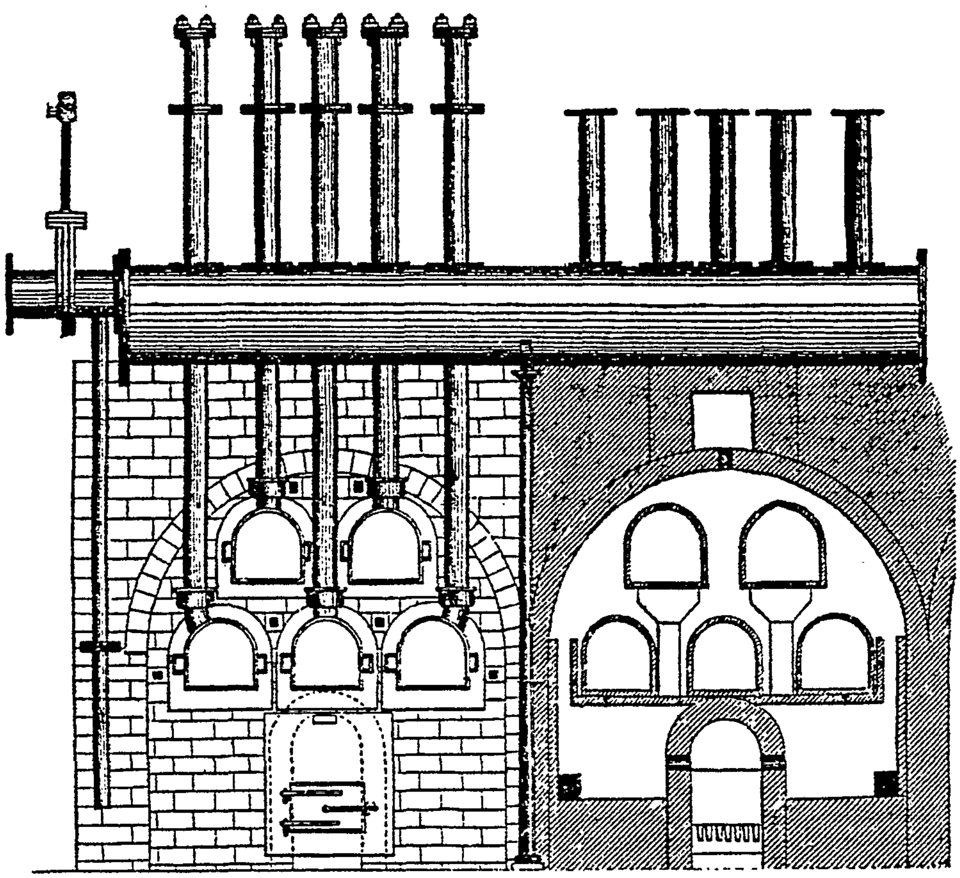
During gas production, the open end of the retort (whether of iron or fireclay) was sealed by means of a cast-iron mouthpiece and lid. The mouthpiece was fastened onto the retort with iron bolts and cement. A short tube also fitted onto the mouthpiece where the ascension pipe was set. The diameter of the ascension pipes averaged from 4 to 7 inches. This pipe served to carry off gases and vapors evolved during distillation. A cast-iron lid was fitted onto the mouthpiece and secured by a screw and cross-bar (Park 1880).

Six or eight retorts were built into a "setting," or brick arch, beneath which a coke furnace burned to maintain the proper temperature (*Figure 12*). A set of retorts, and their heating apparatus, was called a "bench" (Harkins *et al.* 1988:13). The furnace was usually located in a pit with its charging door at ground level (Wilson 1974). The main flue from the furnace and its branches were designed to distribute the heat so that the retorts would burn out evenly. The lower retorts, which by their location could be exposed to greater heat, were protected by fire tiles. A chimney was constructed to keep the furnace at a high temperature and enable the heated air and products to pass off freely. The height and area of the chimney was dependent on the



Source: Park, 1880

Figure 11
Coal Carbonization
Flow Chart and Equipment



Source: Park, 1880

Dover Gas Light

Figure 12
Setting for a Bench of
Five D-shaped Retorts

amount of gas to be produced. At a small works, where 3 to four million cubic feet of gas per year was produced, a 35-foot-high chimney with a 16-inch-square opening was sufficient (Park 1880).

Originally, the coke produced during the distillation process was used for firing the furnace. This was called a direct firing setting and wasted a resalable byproduct. In 1861, the German engineering firm Siemens invented the gas producer furnace in which the coke was burned with insufficient air for complete combustion. The resulting carbon monoxide rose and surrounded the retort vessels. A secondary source of air was admitted to the combustion chamber which burned with the carbon monoxide. This generator type of furnace improved efficiency and was commonly found in small gas works in Britain until the 1930s. The regenerator setting was developed in 1885 when the Klonne recuperator was invented. The regenerator setting forced the outgoing hot gases to pass through a series of brick passages where the gases were mixed with a secondary air source, and combustion occurred around the retorts (Wilson 1974:35).

As the gas was distilled out of the coal, it was drawn up through a conduit called an ascension pipe (or stand-pipe) from which it passed through a "dip pipe" to the hydraulic main, which was the first element in the condensing process. To aid in the transfer, an exhauster, or rotary pump, was used to pump the gas from the retorts to the condenser, washer, purifier, and finally to the gasholder. The hydraulic main was a large, horizontal tube which extended the entire length of the retort house. It was made of wrought-iron 1/4- or 3/8-inch-thick depending on its diameter. The hydraulic main was placed on the top of the furnace, and was supported on cast-iron stands or crutches, which were mounted on cast-iron piers placed over the piers of the ovens, so that the main was distant from the excessive heat (Park 1880). The main was filled with tar and ammoniacal water which was maintained at a constant level by an overflow mechanism to a tar well. The liquid acted as a sealant to the pipes so that gas could not escape during the draining and charging of the retorts.

From the hydraulic main, the gas passed to the condenser, a series of iron tubes, about 6 inches in diameter, placed in cisterns of cold water or exposed to the air. There the gas cooled, and the tar, which had been suspended through the gas, was deposited into an underground storage tank. The tar and ammoniacal liquor were also separated during the condensation process by directing the flow into different wells from the gas.

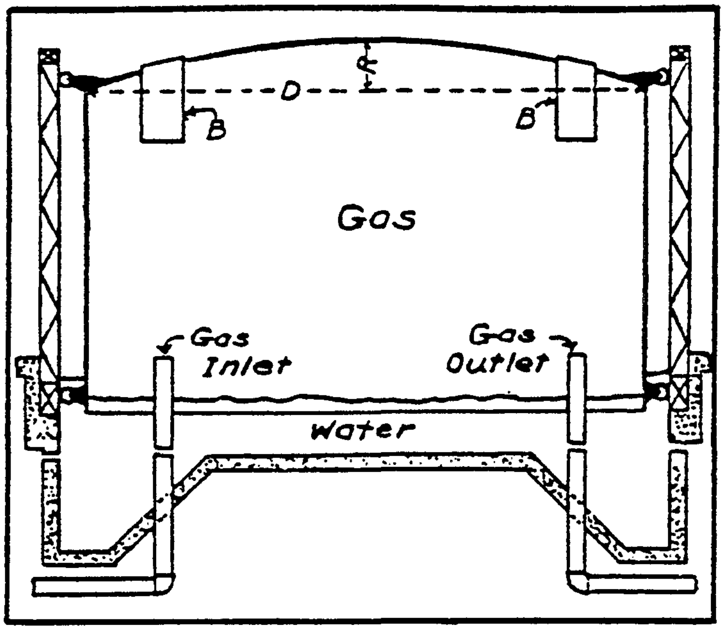
The coal gas was then passed to a washer and a scrubber, or directly to a scrubber if a washer was not used. The washer was a square, iron vessel into which the crude gas passed from the top. The vessel was nearly filled with water and also contained tubes which were pierced with fine holes. The gas was allowed to bubble through these holes, the diameters of which were narrow enough to prevent the tar from entering. The tar sank to the bottom and eventually into the tar well. The washing and scrubbing stage removed much of the sulphuretted hydrogen and sulphur compounds as well as the last of the tar and ammonia. The scrubber was a tall, cast iron tube about 4 feet in diameter filled with broken brick or wooden grids. The gas passed slowly upward through the tube and was sprayed by water from the top.

The gas was then passed into the purifiers in order to remove the last of the hydrogen sulfide. At small gasworks this was accomplished by passing the gas through iron boxes containing slaked lime. Purification using iron oxide superseded the slaked lime method. In this process, four cast-iron boxes, about 8 feet square, were lightly packed with iron oxide or bog iron ore in layers and the gas passed through them in series. The hydrogen sulfide formed iron sulfide and sulphur which remained in the boxes and the purified gas passed on to a fifth or "catch box." When the box became saturated with sulphur it was removed from the circuit. The oxide was dug out and spread in the yard where the action of the air revivified the oxide and it could be used again in several weeks. When it was spent it was sold to makers of sulfuric acid (Wilson 1974:39). In 1849, a hydrated form of iron was found to be an effective way of purifying. Named for its inventor, the Lauring method was advantageous because the iron could be reused. The preferred method, however, involved the use of iron ore, or "bog iron ore," where the sulfate and hydrated of lime used with the Lauring process were eliminated after it was discovered that they were unnecessary for cleaning the gas.

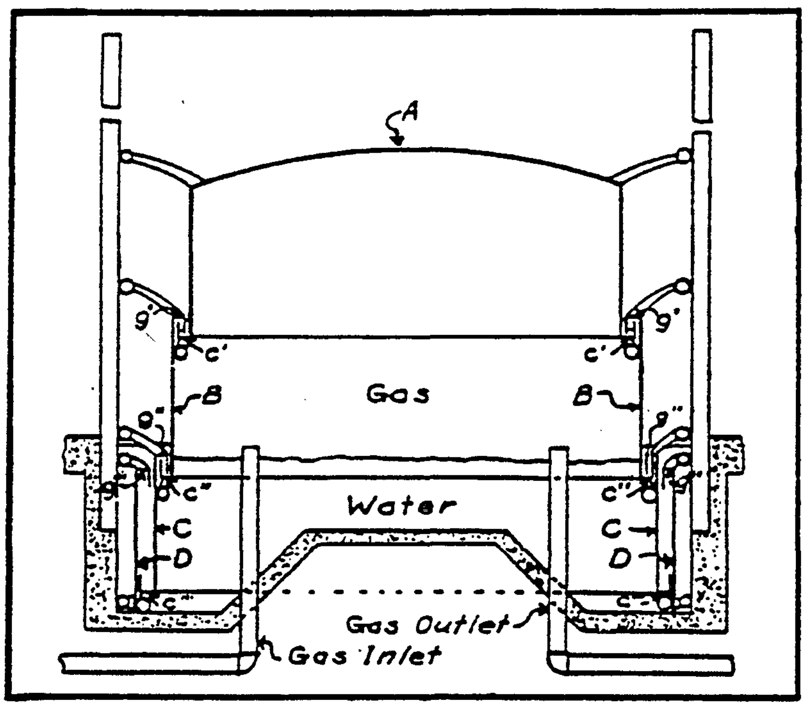
After purification, the gas entered the station meter for reading. The station meter was a horizontal, cast iron drum about 4 feet in diameter and 5 feet long which was filled to the halfway point with water. The gas passed through the drum, which was divided into compartments, displacing the water and making it rotate. The revolutions were counted to give the reading. The difference between the station meter reading and the consumer's reading indicated any gas loss by leaking (Wilson 1974:39).

The Gasholder: The manufactured gas then was stored in gasholders. Gasholders were sometimes called "gasometers" because the quantity of gas stored was indicated by the position of the tank. The gasholder was not simply a means of storage but was also designed to put pressure on the gas for distribution. Pressure was measured not by pounds per square inch but by the number of inches of water that could be supported in a column. There were two types of gasholders: the single lift and the double lift, or telescopic, gasholder, which used counterpoises for vertical movement (*Figure 13*).

The gasholder was an iron or steel bell, open at the bottom, inverted into a tank of water located below ground level. The construction of this pit was usually the most expensive part of building a gasholder. The water tank was constructed with concrete or brick (Harkins et al. 1988:106). The gasholder rose and fell depending upon the volume of gas it contained, with the water providing a seal where the cylinder met the ground. Its movement was guided by a steel frame with upright rods which were fixed at several points, and counterbalanced so as not to exert pressure on the gas at a measurement greater than a 6-inch column of water. For a 150,000-cubic-foot capacity gasholder, the diameter was 87 feet 6 inches and 25 feet high. A 300,000-cubic-foot capacity gasholder measured 100 feet in diameter and stood 39 feet tall. A 12,200-cubic-foot gasholder was 36 feet in diameter and 12 feet in height. The largest gasholder in the world during the 1880s was in London, with a 3,000,000-cubic-foot



Single-Lift Gasholder



Multiple-Lift Gasholder

Source: Morgan in Harkins *et al.* 1988

Dover Gas Light

Figure 13
Cross Sections of
Two Types of Gasholders

capacity and 230 feet in diameter. The largest in the United States at the time belonged to the New York Gas Light Company and was 168 feet in diameter and stood 70 feet tall. Its capacity was 1,500,000 cubic feet (Park 1880:923-924).

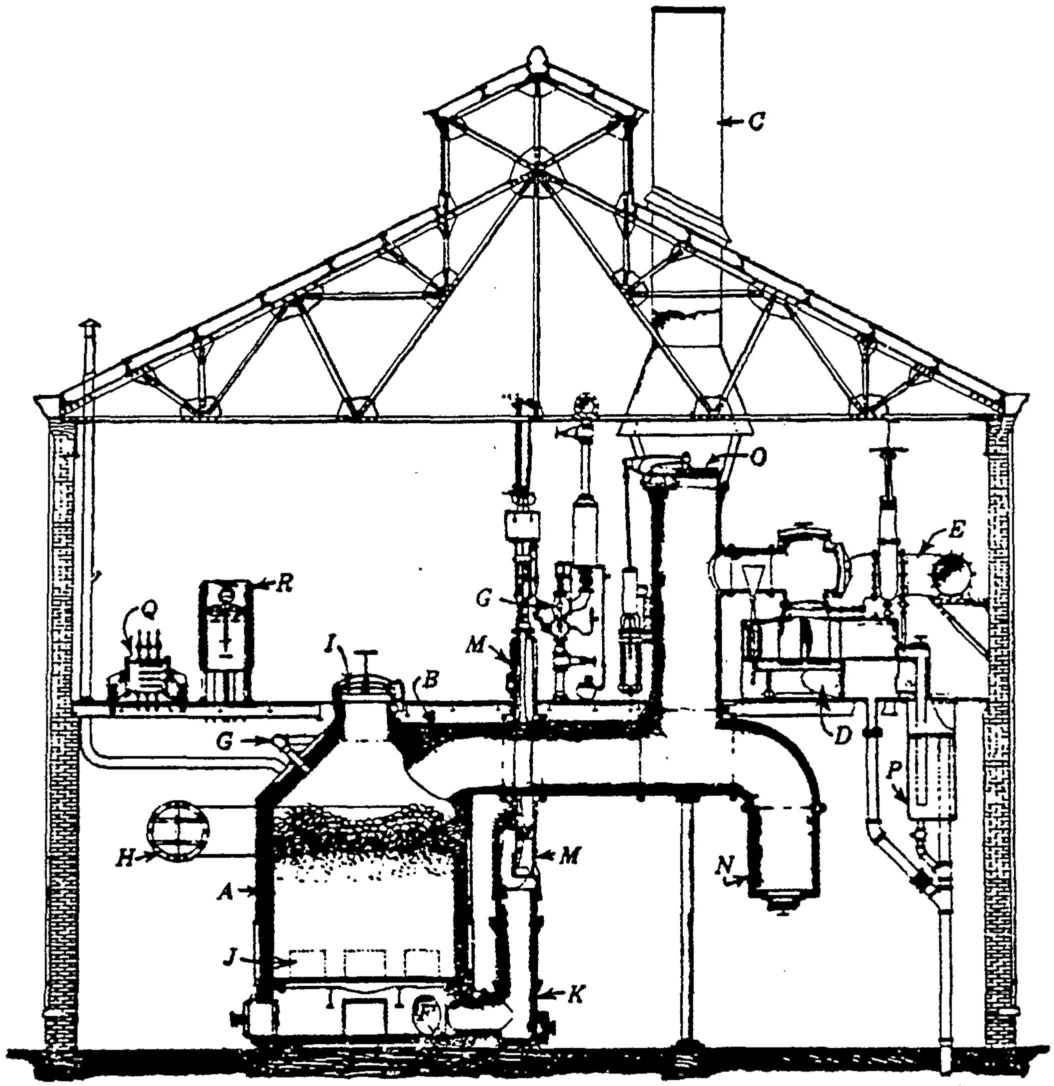
Since gasholders were made of thin sheet iron and were exposed to the elements, they were subject to corrosion. Ice was the greatest hazard. If the water in the tank, or in the upper lutes of a multi-lift holder froze, the lifts became immobile. It was impossible to add manufactured gas into a frozen holder, and, as the gas was drawn off by the town, a vacuum would be created and the roof of the holder usually caved in, causing very serious damage (Wilson 1974:40). Only a small fraction of the gasholders built in the United States were sheltered by houses, constructed to keep the water seal from freezing, and more importantly, to protect the holder from snow loads and high winds which would impair operation. Nearly always, in New England and New York, these houses were round brick buildings with conical slate roofs. Cupolas allowed leaking gas to escape with relative safety. However, the gasholders in Dover do not appear to have ever been housed in this way, probably in part because of the relatively mild climate.

2. Carbureted Water Gas Process and Equipment

Water-gas or blue gas was produced by passing steam through a bed of hot coals. The steam reacted with the carbon to produce a fuel gas composed primarily of carbon monoxide and hydrogen. This gas contained fewer tar and coke waste products than the gas from coal carbonization; however, it had poor luminosity. This problem was solved by T.S.C. Lowe's invention of the carbureted water-gas process in 1875 which involved the "thermal cracking of liquid hydrocarbons into the blue gas which produced carbureted water-gas" (Harkins *et al.* 1988:24). This gas had a higher heating value and luminosity than coal gas. As a result, it became the predominant form of gas production in the United States until the end of the manufactured gas industry (Harkins *et al.* 1988:24). The growth of the petroleum industry after the 1880s, made the production of the carbureted water-gas possible because petroleum provided the inexpensive source of hydrocarbons (Harkins et al. 1988:24).

Main Processing Plant: The apparatus for producing carbureted water gas typically was housed in a two-story brick building. Figure 14 shows the design of a building housing a water or "blue gas" generator. Although this generator only comprises one third of the apparatus for carbureted water-gas, this figure illustrates building construction and placement of the equipment.

There were three components to the carbureted water-gas apparatus: a generator, a carburetor and a superheater (*Figure 15*). The generator was filled with coal through a man-hole which was flush with the second floor of the building. The carburetor and superheater were checkerbricked with firebricks. The bricks were arranged to ensure that the greatest surface area was exposed to gases flowing through (*Figure 16*) (Harkins *et al.* 1988:26):

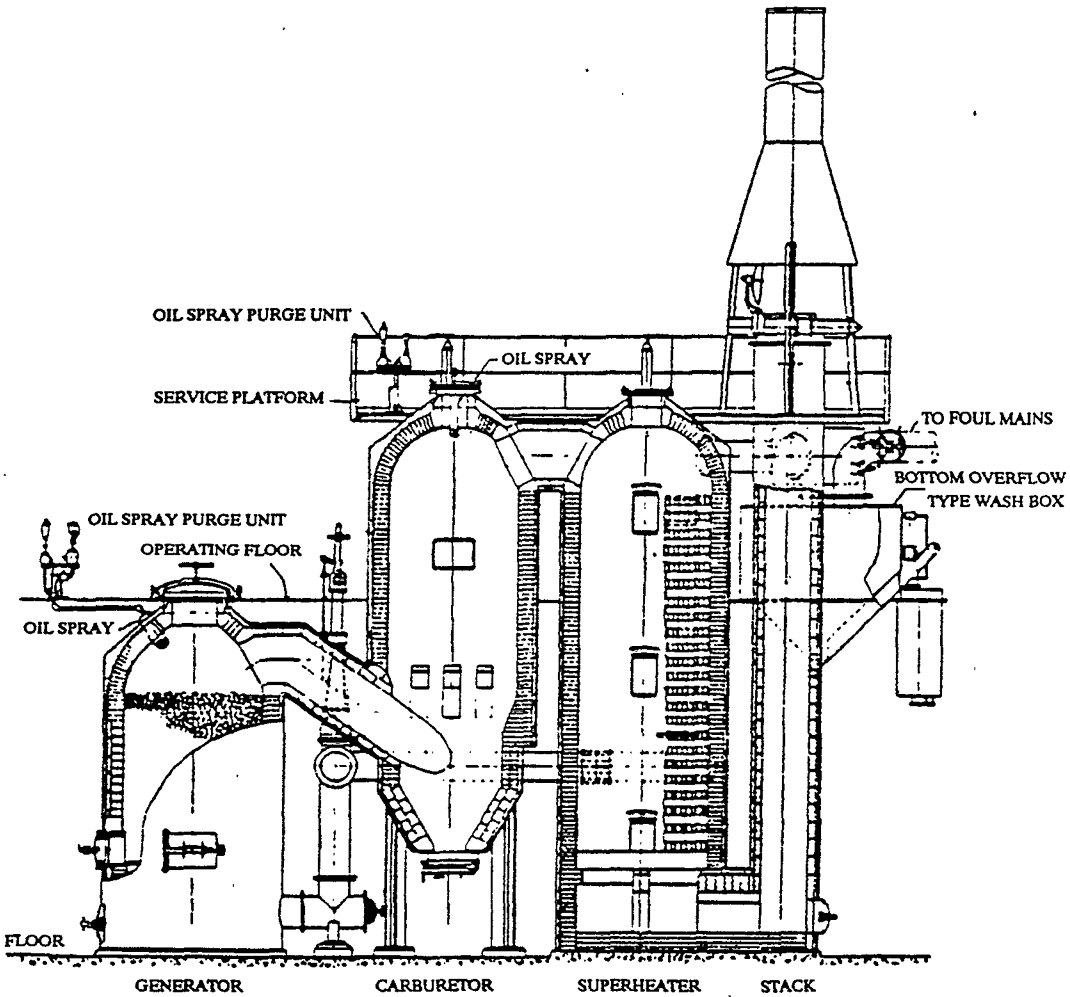


A:	Generator	I:	Coaling door
B:	Gas off-take or hydrogen pipe	J:	Clinkering doors
C:	Stack	K:	Bottom gas off-take
D:	Wash-box, or seal separator	M:	Heat valves
E:	Hot main connection	N:	Dust catcher
F:	Blast connection	O:	Stack valve
G:	Steam connection	P:	Drain tank
H:	Explosion door	Q:	Controls
		R:	Instrument board

Source: Morgan in Harkins *et al.* 1988

Dover Gas Light

Figure 14
Section of a
Processing Building
and Water-Gas Generator



Source: Morgan in Harkins *et al.* 1988

Figure 15
Section of a
Carbureted
Water-Gas Set

This apparatus operated in a cyclical manner, with alternate blows to heat the coke bed and the checkerbrick, followed by runs in which blue gas was produced and hydrocarbons cracked into the gas from oils sprayed onto the hot firebrick of the carburetor. The raw gas was then passed through a wash-box or hydraulic main and a condenser. Because the production of gas was not continuous, a relief holder was used to dampen the gas flowrate changes and provide a relatively constant flow through the exhauster, tar extractor and purifiers. From there the gas continued through the metering and distribution system (Harkins *et al.* 1988:26).

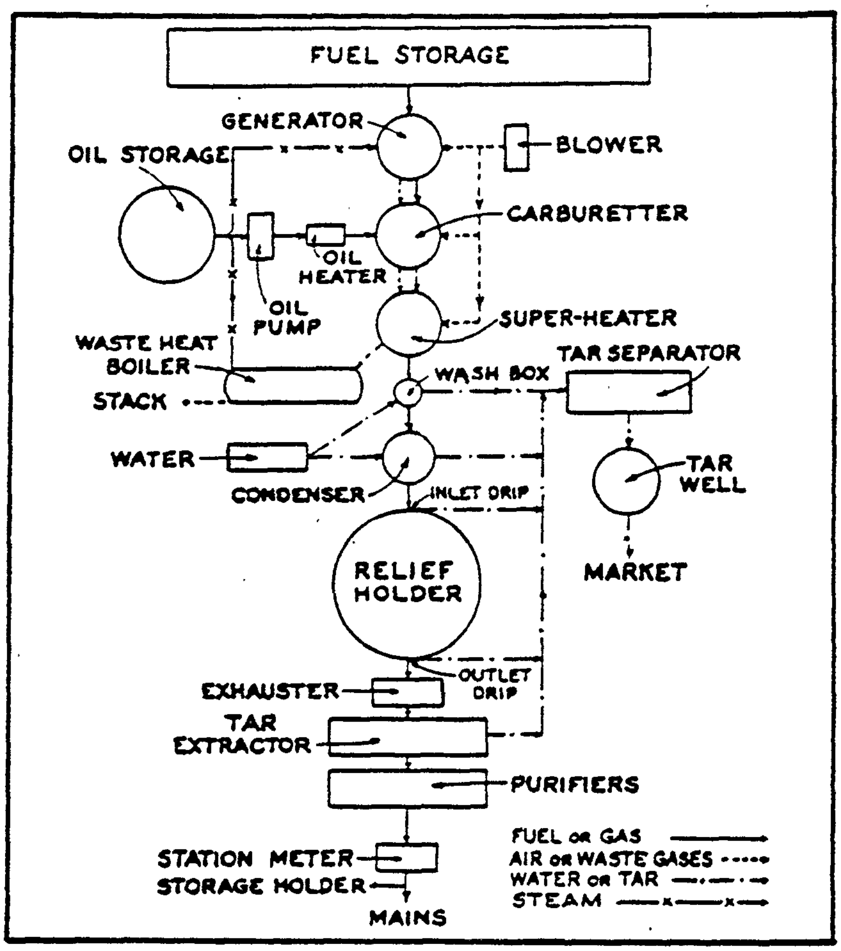
C. Gas Manufacture at the Former Dover Gas Light Site

Prior to manufacturing gas from coal, the Dover Gas Works produced gas from both coal oil (i.e. kerosene) and resins. For the coal oil process, gasification is achieved much the same as with solid coal. This process also used retorts, which were often filled with bricks or lumps of coke to increase the temperatures and thus shorten the gas production time. Cast iron retorts were used almost exclusively for oil-gas works. The production of oil-gas is a continuous process and thus differs from coal distillation, which involved removing the coke from the retorts. The resin-gas process is virtually the same as with oil-gas production although the resin must first be liquified before distillation in the retort (Park 1880:944-945). Between 1885 and 1897, the main processing building at the Dover Gas Light Company was constructed and gas was made by a different process. By 1910, the company was using Lowe's carbureted water-gas process (Eng 1985:B-52). The oil tank shown on the site in 1910 indicates the production of this form of manufactured gas (Versar 1991:9-10).

The most detailed information regarding the gas production, equipment and the structures at the former Dover Gas Light site can be pieced together from early twentieth century photographs, historic maps and the depositions of former employees. At this time gas was being manufactured by the carbureted water-gas process in the main processing building and the retort building was no longer used for its original purpose. Historic maps and early twentieth century photographs show the locations of the equipment and the architectural design of the exterior of the retort building, the main processing building and a gasholder. Depositions of former Dover Gas Light company employees provide information regarding the production of gas and equipment in use during the mid twentieth century and the closure and demolition of the plant during the late 1940s.

1. Architectural Analysis

<u>The Retort Building</u>: The circa 1868 retort building, demolished in the mid-1980s, was analyzed by examining Sanborn insurance maps and the only known photograph containing this structure (Plate 1). The retort building was a 1-1/2-story brick structure with a perimeter measuring approximately 20 feet by 20 feet. According to the 1885 and 1897 Sanborn maps, its interior plan contained a retort room, condenser room, meter room, and purifier room. It had a low-pitched, pyramidal roof, pierced by corbelled brick chimney stacks originating in the meter



Source: Morgan in Harkins *et al.* 1988

Figure 16
Flowsheet for a
Carbureted
Water-Gas Plant

room and purifier room (see Plate 1). A windowless door, perhaps four feet across, is visible in the historic photograph (Plate 1).

The historic photograph shows that by the early 20th century, the building was covered with ivy. Its west elevation appears to have two small window openings, located on either side of the door, which may have been original.

The Main Processing Building: Between 1885 and 1897 a new, two-story, gable-roofed brick building was constructed for the generator/blower/meter functions, with a separate one-story, shed-roofed brick section for additional purifying. According to the Sanborn maps and the historic photographs of the complex (Plate 2), the two-story portion was eventually covered with corrugated iron for siding and roof sheathing; it is presumed that its original architectural detailing was similar to that of the shed-roofed extension. The extension has seven-course brick bond with decorative dentils; the six 6-pane windows have stone lintels and stone flat arches similar in character. The two-story portion has a louvered ventilator on the roof, and the extension's roof is pierced by a large, cylindrical brick stack with corbelling at the top.

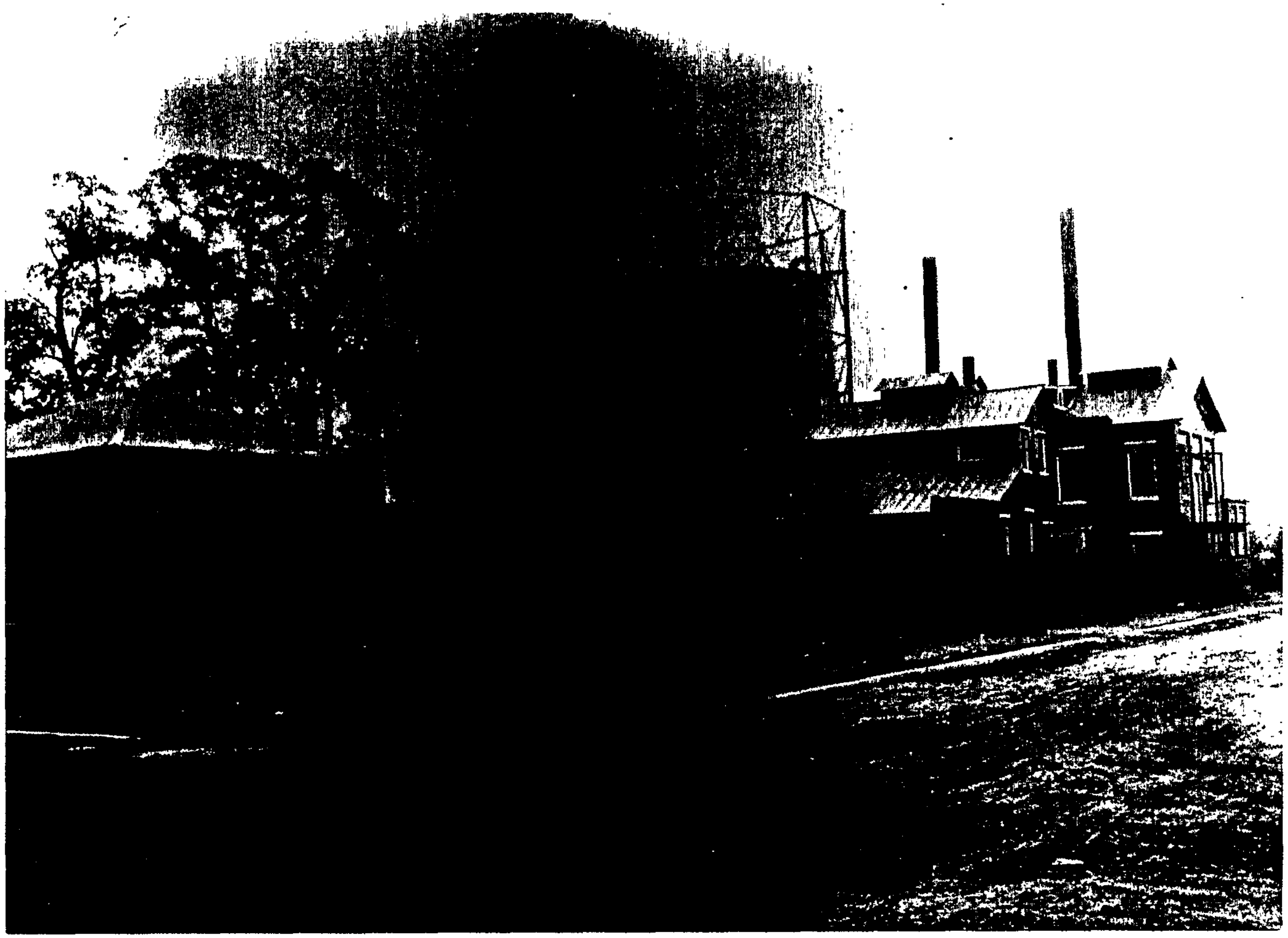
By 1910 a two-story addition to the north side nearly doubled the size of the generator/blower/meter building. The new portion was articulated in brick, with similar stylistic details as the original building. It also had a louvered ventilator on its roof (see Plate 2).

By 1919, this complex had a one-story, shed-roofed addition to its south side. This addition was made of brick with seven-course bond. By this date it also had two new gasholder with capacities of 100,000 and 20,000 cubic feet. From the historic photograph, these gasholders appear to have been made, like other gasholders of the period, of thin sheet iron or steel sections, reinforced by a skeletal metal frame whose members were stabilized with tension rods.

2. Descriptions of the Dover Gas Light Company by Former Employees.

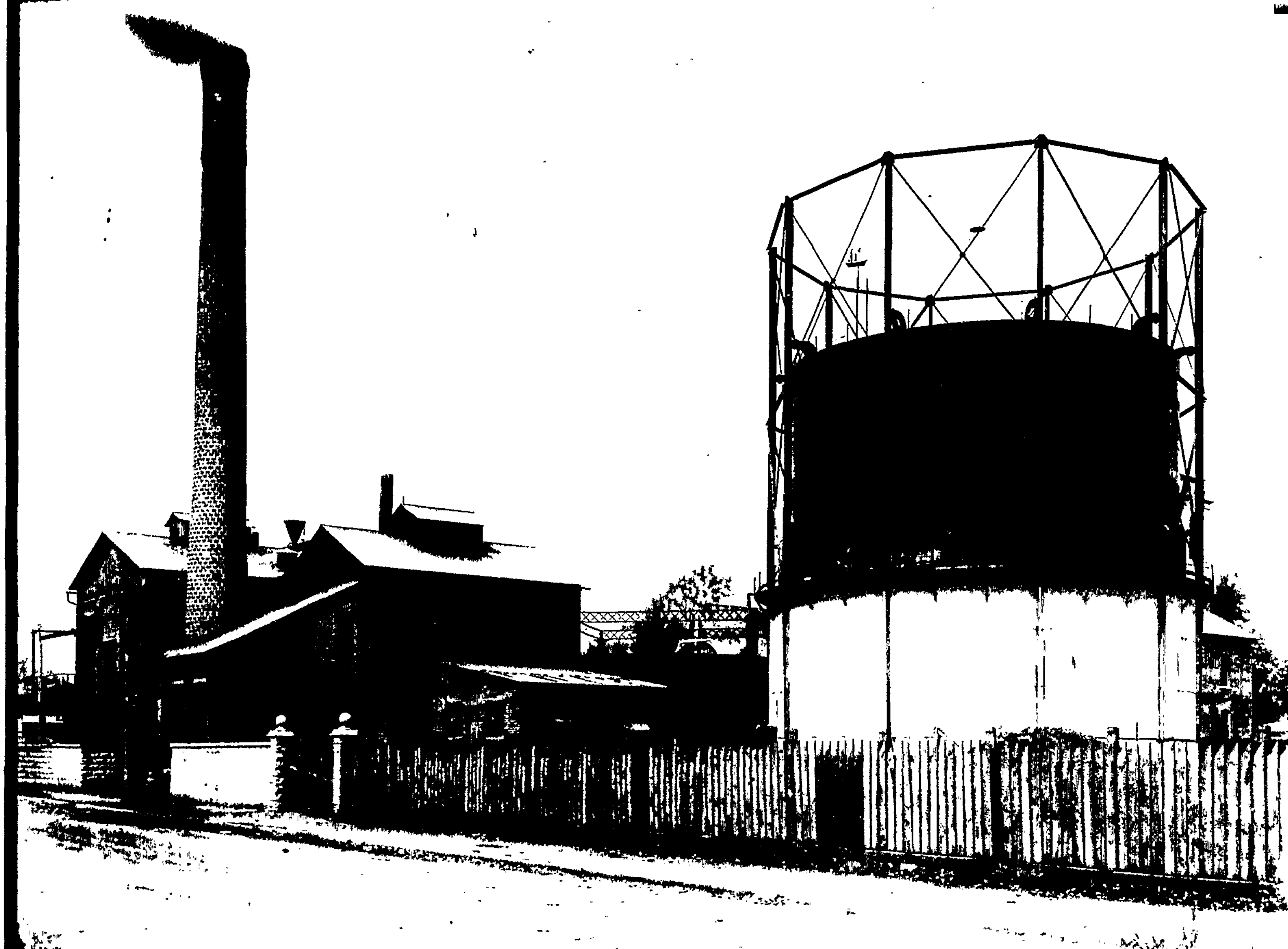
During the fall of 1988, depositions of the former Dover Gas Light Company employees and some Dover residents were taken while investigating the operations at the plant site. This investigation focused on identifying the locations of all the structures associated with the plant; the method of storage of raw materiel; the disposal of by-products at the former Dover Gas Light Site; and the demolition and removal of the structures, machinery and by-products at the site when it closed during the late 1940s. The depositions of the former employees, Ferris Wright Sr., William R. Staats, John W. Conley, and Frank Burris, provide valuable information regarding the plant's operation and closure.

Ferris Wright, Sr. worked as a gasmaker at the plant from the mid 1930s to 1948. He is no longer living. William B. Staats was employed from 1929 to 1952 as a serviceman. His duties included excavating roads and yards to install pipes as well as



Source: Delaware State Archives

Plate 1
Dover Gas Light Co.,
Early 20th Century



Source: Delaware State Archives

Dover Gas Light

Plate 2
Dover Gas Light Co.,
1929

connecting appliances inside homes, and general maintenance work (Staats 1988:10-11). Staats reported to the gas plant every morning. He received his orders at the old retort building. John W. Conley worked as a helper and journeyman. He was employed from 1946-1949 and 1950-1960. Frank Burris also worked at the old Dover Gas Light Plant, from 1947 to 1950. He was in his mid-teens at this time and served as a "helper" to the journeyman, excavating for the installation and fitting of pipes and mains. He also did odd jobs at the plant. For example, he assisted in cleaning out the purifiers and removing the clinkers from the generators (Burris 1988).

Manufacturing Process and Equipment

The memories of the men deposed tended to vary slightly as far as what structures were extant on the site. All remembered the old retort building (converted into office and storage), the newer processing building, one or two gasholders (a large one which held gas and a small one which held tar), a chimney stack, at least two purifiers and at least two tanks along New Steet (only partially below ground) (Wright 1988:96-98; Conley 1988:51; Staats 1988:18).

In addition, two high-pressure gas tanks were mentioned near the corner of the Presbyterian Church cemetery and Bank Lane. Gas from these tanks was pumped to Smyrna, Clayton and Cheswold (Staats 1988:33; Conely 1988:69). A low pressure pipe line came out onto South New Street to feed the city of Dover, and high pressure lines were under Bank Lane, went up Governors Avenue, then turned north (Conley 1988:69).

The employee at the site with the most authority and responsibility was the gasmaker; his assistant was the fireman, who was responsible for firing the boilers and hauling coal. According to Ferris Wright, Sr., the gasmaker worked a 12-hour day or night shift during the early twentieth century. However, during the 1930s, under President Roosevelt's administration, the company was required to put in four shifts (Wright 1988:89). Wright learned the trade from the previous gasmaker whose name was William Smith.

All the men remembered that gas was manufactured in the main processing building. Conley described it as being constructed of brick and metal, the roof being of metal and the sides of the building were part metal and part brick (Conley 1988:24). Wright explained before he came to the plant, the small retort building was used to make gas and the owner at that time was Richardson. He explained that the new building was constructed in order to supply the increasing number of customers and because the way of producing gas was changed (Wright 1988:48).

Wright mentioned two gas machines in the two-story processing building, one located at each end of the plant, and that only one was used at a time (Wright 1988:17). The machinery necessary for producing the gas were the generator, carburetor and superheater. Staats stated that there were two generators and only one was used at a time (Staats 1988:24). Another employee, Conley described the generator and the condenser as measuring approximately 12 to 14 feet high and extending into the second floor (Conley 1988:75).

The first step in the gas manufacturing process was to load coal into the generator from an opening on the second floor of the building. The coal was loaded into a cart with a 500-pound capacity, hauled to an elevator at the processing building, and poured into the generator (Wright 1988:29). Conley recalled that this elevator was located at the left door of the two which jut out from the processing building (Conley 1988:75). He described the cover of the generator as being similar to a "big manhole cover" but with a "T-handle" which locked it down (Conley 1988:75-76).

Wright explained the generator had to be extremely hot before the coal was loaded and that there was a glass through which "you could see your heat." The interior had to be a white, "almost as white as a sheet" (Wright 1988:31). After loading the coal, additional heat was "blown" into the generator in order to "make a run" (produce gas). Gas could be produced for a period of four minutes (Wright 1988:24)

The hot gas would then pass to the carburetor and the superheater. The carburetor and the superheater were both filled with layers of brick and these would also be heated.

Periodically, the generator had to be cleaned by chipping off the clinkers which had formed inside it. Wright explained that two people were needed to chip off the clinkers; one man held a "15-foot chisel bar" in place while another hammered with a "20-pound sledge hammer" (Wright 1988:30).

Staats explained that a boiler fueled with soft coal was also necessary to the gas manufacturing process. The soft coal (i.e. bituminous) was referred to as Pocahontas and came from the Susquehanna River Valley or West Virginia (Staats 1988:44). In addition, the boiler(s) was vented by a stack which was "close to 100 foot high" (Wright 1988:58). Steam produced in the boiler was blown into the hot coals in the generator with a powerful fan in order to further increase the temperature. Then oil was "forced on top of the hot coals" (Staats 1988:48). Staats explained that the oil increased the BTUs in the blue gas, making it richer (Staats 1988:23, 48). Wright had not really heard of the terms water gas or blue gas, but stated that fuel oil was added to the carburetor. This oil was stored in an underground tank and connected to the carburetor by lines and controlled by a valve (Wright 1988:35).

Wright explained that after the gas left the superheater it went to the purifiers and then the gasholder. He thought that the piping was underground (Wright 1988:43). Wright remembered that there were two purifiers, a square one and a round one and that both were filled with wood chips (Wright 1988:44). Conley remembered there being two or three purifiers and described them as being constructed of metal and painted green with "big doors which locked with "nuts and bolt" (Conley 1988:30). He stated that they were oblong, and "maybe 6 or 8 foot wide and 8 or 10 foot long and approximately 6 or 7 foot high" (Conley 1988:32). Staats had assisted in cleaning out the purifier and recalled only a square purifier building which was filled with wood chips and a red oxide powder (Staats 1988:39). He remembered that it was cleaned about every three months. In order to do so, it was ventilated for a couple of days by allowing the door to stand open. Staats recalled that the men wore gas masks to enter the purifier and shovel out the wood chips (Staats 1988:75). Staats explained that piles were made of the used wood chips in order to aerate them and then they were used again. When the chips were stuck together with tar, they could no longer be used and were given to people who used them in their driveways (Staats 1988:42). Conley also recalled cleaning out the purifiers; however, he stated that the used wood chips were taken off the property by truck and taken to the City of Dover dump (Conley 1988:42).

Once the gas was purified it was piped into the gasholder. Most of the men remembered that there were two gasholders. Wright and Conley stated that the smaller one contained tar. From these statements, it is assumed that the smaller gasholder was no longer used for its original purpose, but was being used for tar storage. Staats could only remember the large one and described it as having about a 60-foot frame, and that the holder would rise and fall depending upon the amount of gas it contained (Staats 1988:19). Staats recalled breaking the ice formed around the main gasholder in order to free it during the winter (Staats 1988:20). Wright said that the smaller tank was "close to 20 foot high" and that it could go down to being almost flat if they let it. He thought the hole below it would have been as deep as this little tank was high, and that there was a walk around the tank (Wright 1988:51, 54). Conley also recalled that the large tank rose and fell. However, his recollection of the smaller tank was that it was stationary (Conley 1988:61). These contradictory statements about the smaller gasholder reflect a difference in memory between the two men. All the men were unsure about how the base of the gasholders were constructed.

Demolition of the Dover Gas Light Site

Wright stated that when he was ordered to close the plant in November of 1948 he shut everything off, "closed the door and left" (Wright 1988:95). Wright believed that a crew was brought down from Pennsylvania to dismantle the plant.

Conley and Burris demolished the smokestack by hand with sledgehammers over a two-year period (Conley 1988:109; Burris 1988:46). Conley explained that they positioned themselves inside the smokestack and knocked the bricks out from the inside. People living in the area came and took the bricks (Conley 1988:107).

Conley stated that a salvage or demolition crew from "up north," maybe Wilmington, took down the rest of the plant and salvaged the equipment (Conley 1988:110). He also stated that the various tanks and gasholders were pumped out before they were cut up with blow torches. He explained that the gasholders were cut apart from the top and taken down in sections. Some pieces were removed by hand and others with a crane. After the exterior of the gasholder was dismantled a "wooden structure, like a scaffold" remained standing (Conley 1988:123).

The wood was taken away and the metal was hauled away as scrap (Conley 1988:111, 117, 126). After the salvage crew had taken what they wanted, another contractor was brought in to complete the job. Conley recalled that the contractor was

Ward Hurley (Conley 1988:125). He stated that Hurley dynamited whatever he could not push with a backhoe or jackhammer, especially the concrete forms for the purifier (Conley 1988:139-140). He took the concrete to the dump and then brought "select material" to fill the holes. Conley described this select material as "gravel or a dirt" (Conley 1988:122). Finally, Hurley leveled the whole site (Conley 1988:131). Conley could not say whether the foundations of the tar tank and gas tank were masonry, metal or earth.

Hurley testified that he had leased a backhoe, front-end loader and driver for use in demolishing the gas plant (Hurley 1988:24). In addition, his operator dug up some pipes that were behind the small gasholder and backfilled everything (Hurley 1988:24). He also added that the scrap metal was taken to Louis Gross scrap yard in Dover (Hurley 1988:45).

Louis Gross is deceased (1950), but his son Morris Gross remembered that his father was involved with the demolition of the plant; however, he himself does not remember the details(Gross Interview 1992).

D. Site Evolution

The site evolution, or development, of the Dover gas works is based on a review of the 1868 Pomeroy & Beers Atlas map and the Sanborn Insurance Maps from 1885 to 1950, which typically quite accurately record significant physical alterations to buildings on a site by means of the site plan, symbols and color codes. Maps for the years 1885, 1897, 1910, 1919 and 1929 are presented in this study to illustrate these changes.

1868	In 1868, the retort building, which stood until the mid-1980s, and one gasholder are shown on the site. The house which appears later in the northwestern corner of the property is not shown in 1868. New Street, which later forms the western boundary of the gas works, was not cut through south of Loockerman Street at this time (*See Figure 7*).
1875	In 1875, Richardson and Robbins constructed a residence on the site of the gas plant. It was tenanted by Peter Moore, who was known to have worked at the gas plant from 1881 to 1883. The structure appears on a plat drawn at Robbins' death in 1876 *(Figure 8)*. It is shown as a 2-story structure with a cross gable.
1885	In 1885, the site occupied roughly one-fourth of a city block. The works was comprised of a coal shed; two iron or steel gasholders which were not enclosed in gasholder houses; one building marked as a two-story dwelling and located in the northwest corner of the site; and one

building which was roughly square in plan. This latter structure housed the retort, the condenser, the meter, and the purifier (in large plants, the retort, condensers, and purifiers were often housed in separate buildings by function). In the retort room, the coal was burned to produce a crude gas. The gas was then condensed to separate coal tars from the gas before purification which removed sulphur from the gas (*Figure 17*).

1891 The only recorded alteration to the site between 1885 and 1891 was the extension of the coal shed to almost double its original size, from North Street to the property boundary on the south (Sanborn 1891).

1897 By 1897, the coal shed remained large. A third gasholder was added to the site and appears slightly smaller than the original two. The original structure housing the retort, condenser and purifier was no longer used for their original purpose. A building was added to the southwest corner of the site to house the generator, blower, and meter with a separate room for additional purifying. The area surrounding the house in the northwest corner is shown by 1897 as a separate lot from the gas works. This structure is still used as a dwelling, and has a single-story rear addition (*Figure 18*).

1904 After the turn of the century, the original retort, condenser and purifier building was not in use. The new processing building was extended further north, with the engine room adjacent to the old iron gasholders. The coal sheds on the eastern boundary of the property had been removed (Sanborn 1904).

1910 By 1910, one of the gasholders had been removed and the vacated retort building was being used for storage of coal and baled shavings. A gasholder with twice the capacity of the originals had been added to the southeast corner of the site. One oil tank, on the eastern boundary of the site, was located 2 feet above the ground and replaced the former coal sheds. Another oil tank, level with the ground, was on the western boundary of the lot, adjacent to South New Street. The processing building was now rectangular, with another addition on the south used as a purifying room. There was a coal shed along its east side. The building housed additional generators. A platform was added to the western boundary of the property connecting the purifying room and one of the oil tanks (*Figure 19*).

1919

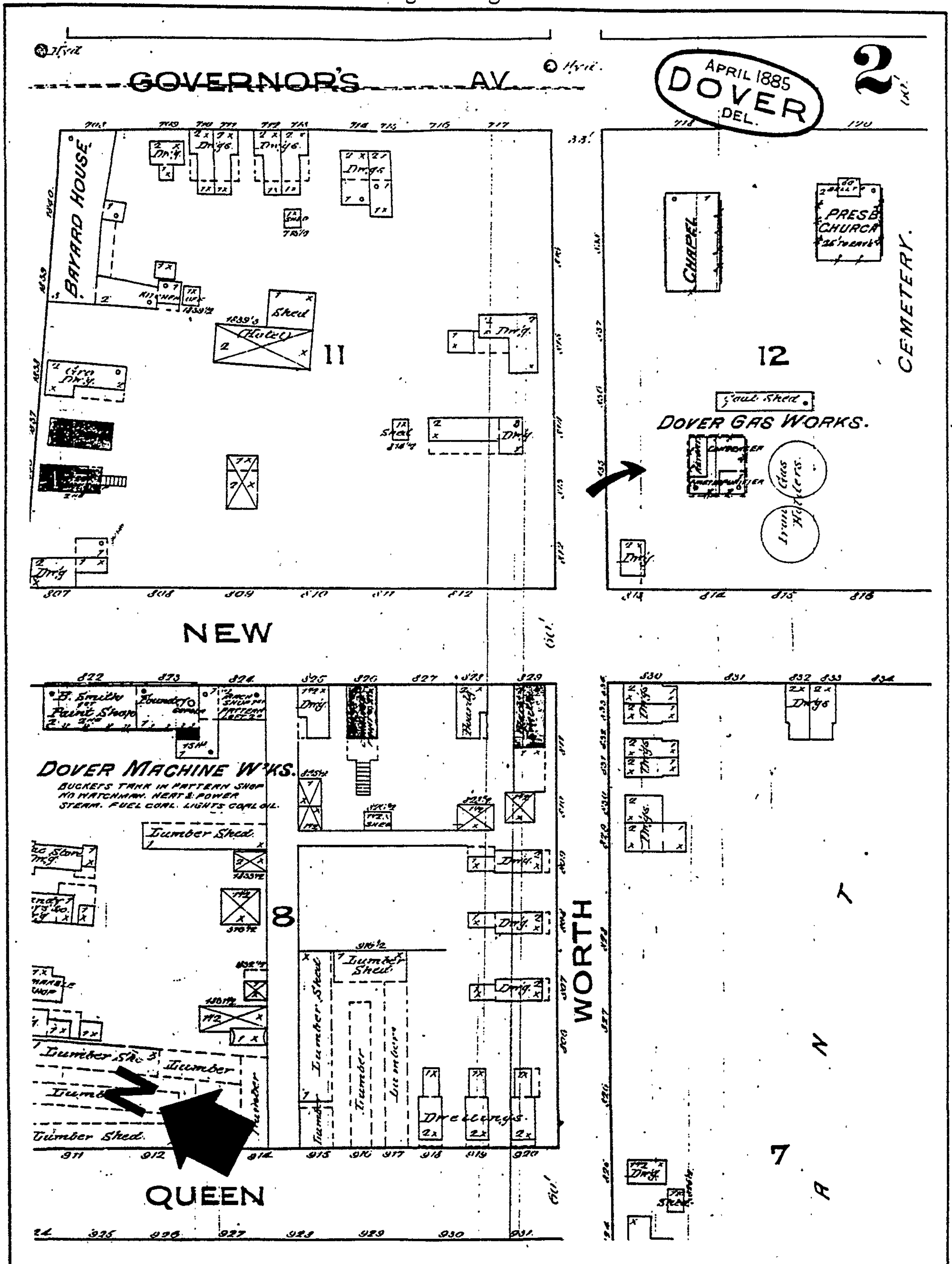
By 1919, the boundaries of the gas works had doubled with the extension south to Bank Lane so that the works occupied the entire western half of the block. The original retort building was still used for storage, but the oil tanks were then listed as tar tanks. A third tar tank had been added in the southeast corner. The last original 10,000-cubic-foot-capacity gasholder had been demolished, and a 100,000 cubic feet capacity holder was constructed south of the one added between 1904 and 1910. An L-shaped addition to the processing plant resulted in a building which was roughly T-shaped. Although in the same location, the tar tank nearest this building may have been a replacement because it was larger in size and sat 2 feet above ground rather than at grade. The dwelling along West North Street was now gone (*Figure 20*).

1929

By 1929, a single-story building had been added to the site just south of the oil tank located along the eastern boundary of the property (the oil tank had been used for tar storage in 1919). The function of the new building is not identified. The tank along the western border was also used for oil storage by 1929, and nearby a separate purifier, circular in plan, had been built. An underground tar tank was installed outside of the northwest corner of the main processing building. The tank, located in the southeast corner, was being used for gas storage by the late 1920s. The southernmost ell of the plant had either been enlarged or was an entirely new construction (*Figure 21*).

1929 - 1950

The 1937 aerial photograph shows the presence of a dark stain, probably indicating coal or coke, in the southwest corner of the site. By 1950, the entire site had been razed except for the original retort building, which was listed as vacant.

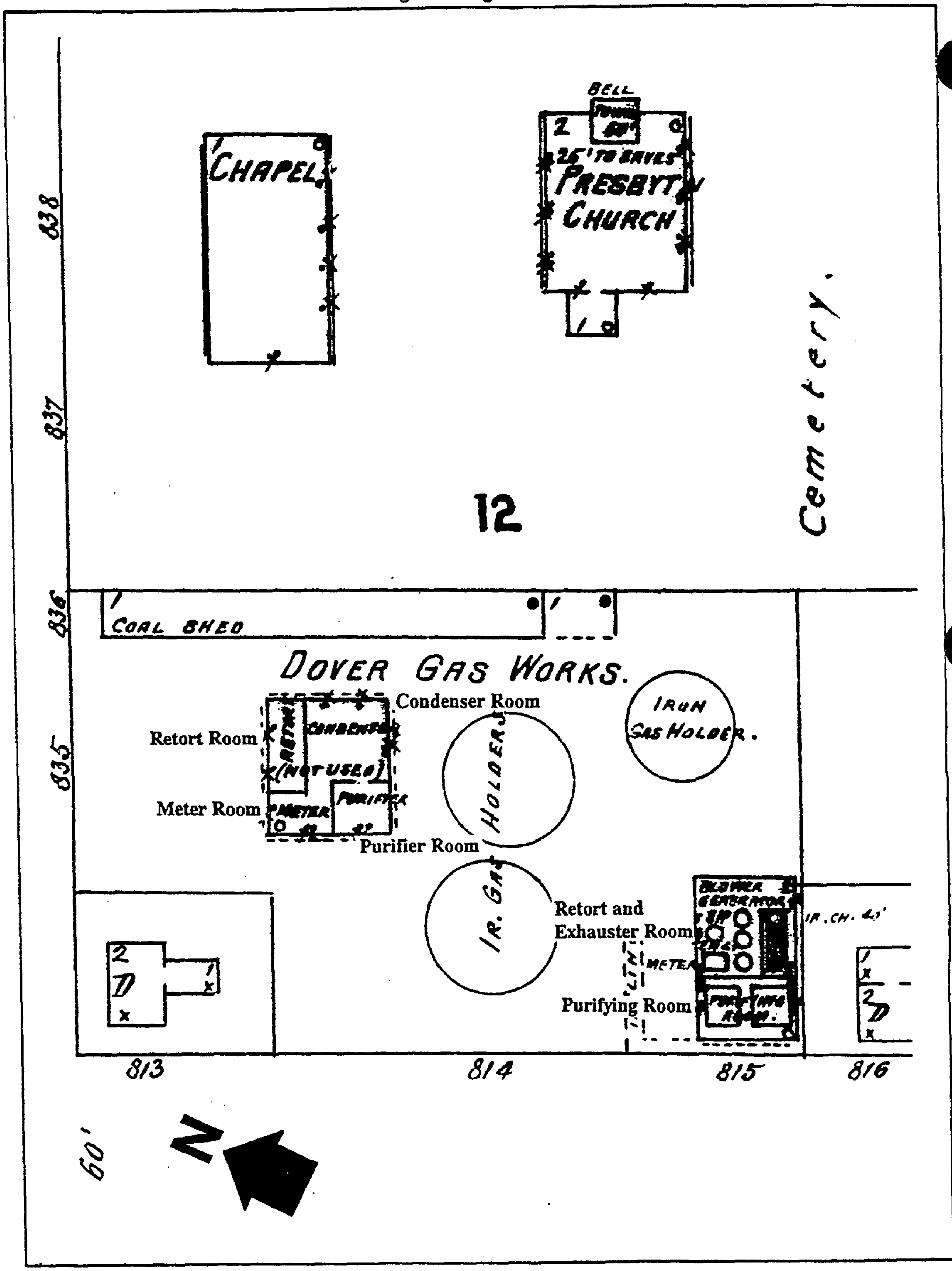


Source: Sanborn Fire Insurance Co. Map, 1885

Dover Gas Light

Figure 17
Dover Gas Works
Site in 1885

AR308497

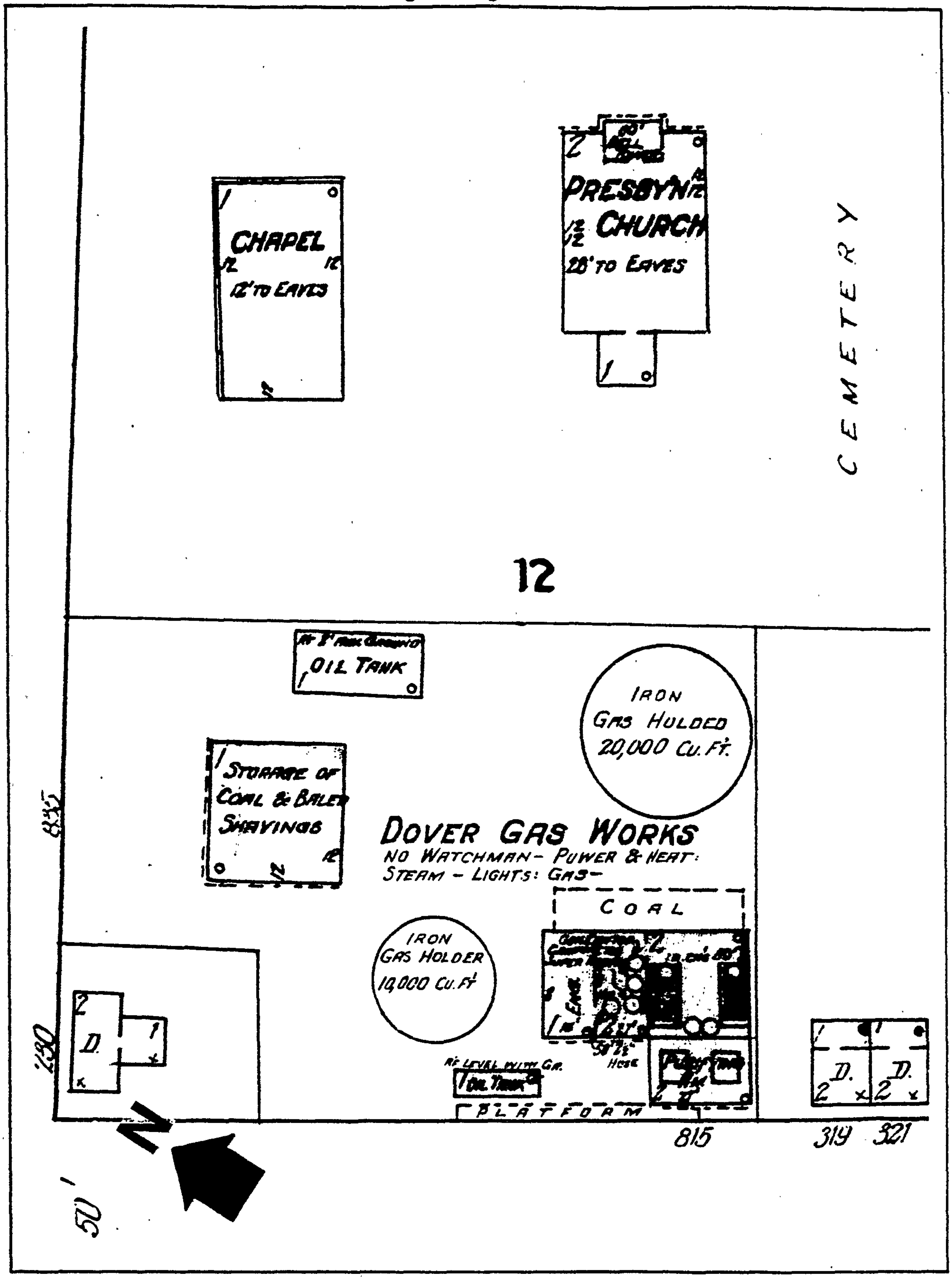


Source: Sanborn Fire Insurance Co. Map, 1897

Dover Gas Light

Figure 18
Dover Gas Works
Site in 1897

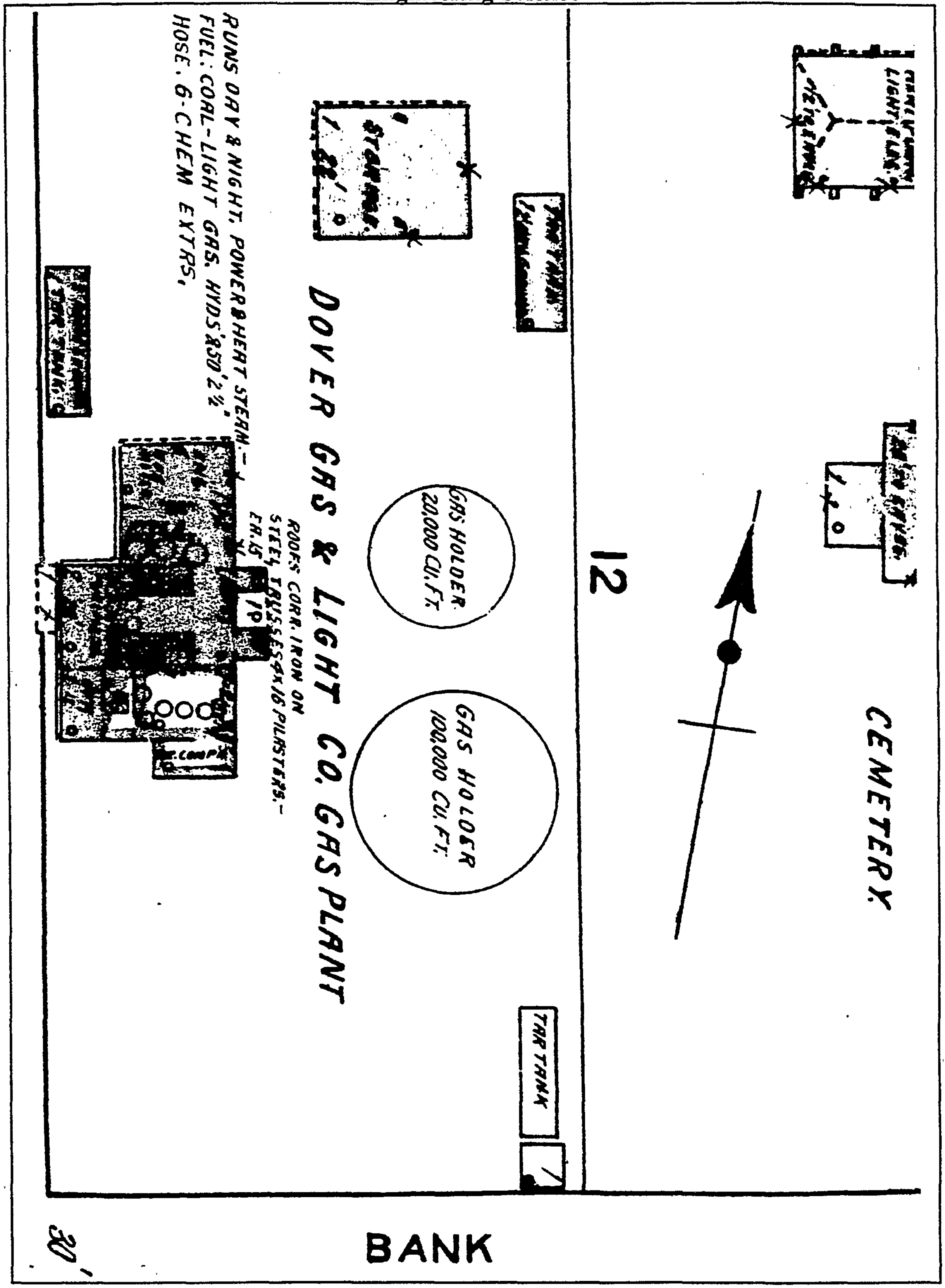
AR308498



Source: Sanborn Fire Insurance Co. Map, 1910

Dover Gas Light

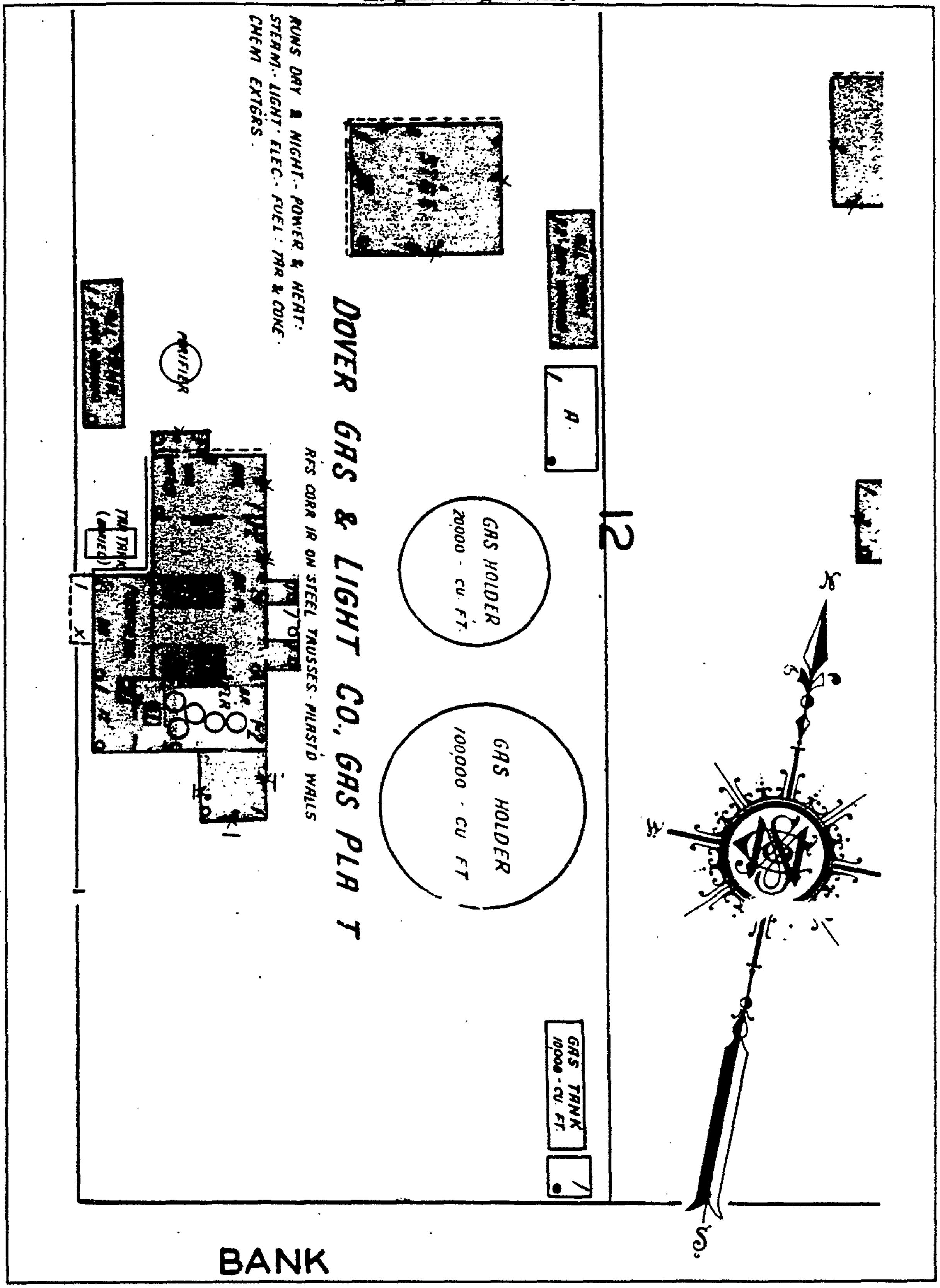
Figure 19
Dover Gas Works
Site in 1910



Source: Sanborn Fire Insurance Co. Map, 1919

Dover Gas Light

Figure 20
Dover Gas Works
Site in 1919



Source: Sanborn Fire Insurance Co. Map, 1929

Dover Gas Light

Figure 21
Dover Gas Works
Site in 1929

VII. DESCRIPTION OF SOIL BORINGS

A total of nineteen soil borings were drilled in the project area. These soil borings were drilled to assess the nature of the geological conditions on the site. The drilling process was monitored, recorded, and evaluated by an archaeologist in order to assist in the prediction of subsurface archaeological resources. Observation of the soil borings allowed for the evaluation of the depth and nature of the fill and assisted in the prediction of the presence and integrity of potential archaeological resources. Placement of the soil borings on the property is illustrated in Figure 22.

B-1 *(Figure 23)*

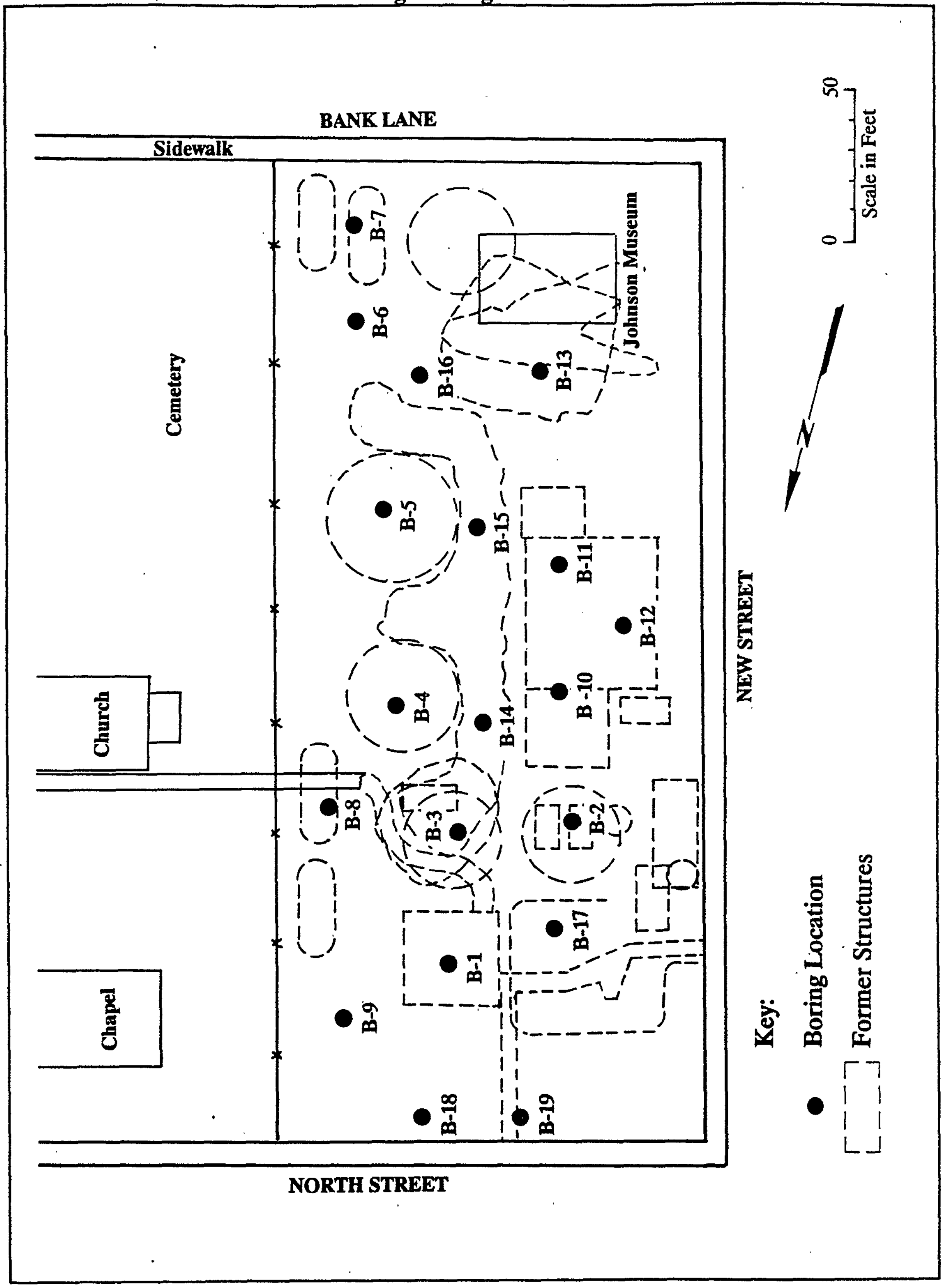
Stratum A:	Tan grey sand (fill)
Stratum B:	Dark grey sand with brick fragments (fill)
Stratum C:	Orange brown sandy silt with brick fragments (fill)
Stratum D:	Orange micaceous sand (fill)
Stratum E:	Yellow brown micaceous sand (fill)
Stratum F:	Orange brown sand (petroleum odors)
Stratum G:	Very dark grey silty sand with dark grey staining
Stratum H:	Tan brown medium sandy clay
Stratum I:	Bright orange coarse sand and gravel
Notes:	*In center of original retort building demolished in mid-1980s*

B-2 *(Figure 23)*

Stratum A:	Bright orange sand and gravel (fill)
Stratum B:	Mixed yellow grey brown sand and medium gravels (fill)
Stratum C:	Very coarse orange sand and gravel (fill)
Stratum D:	Black burnt tar clinker and ash (fill)
Stratum E:	Remains of brick foundation
Notes:	*In the middle of a tank with approximately 5 feet of process-related organic material in tank.*

B-3 *(Figure 23)*

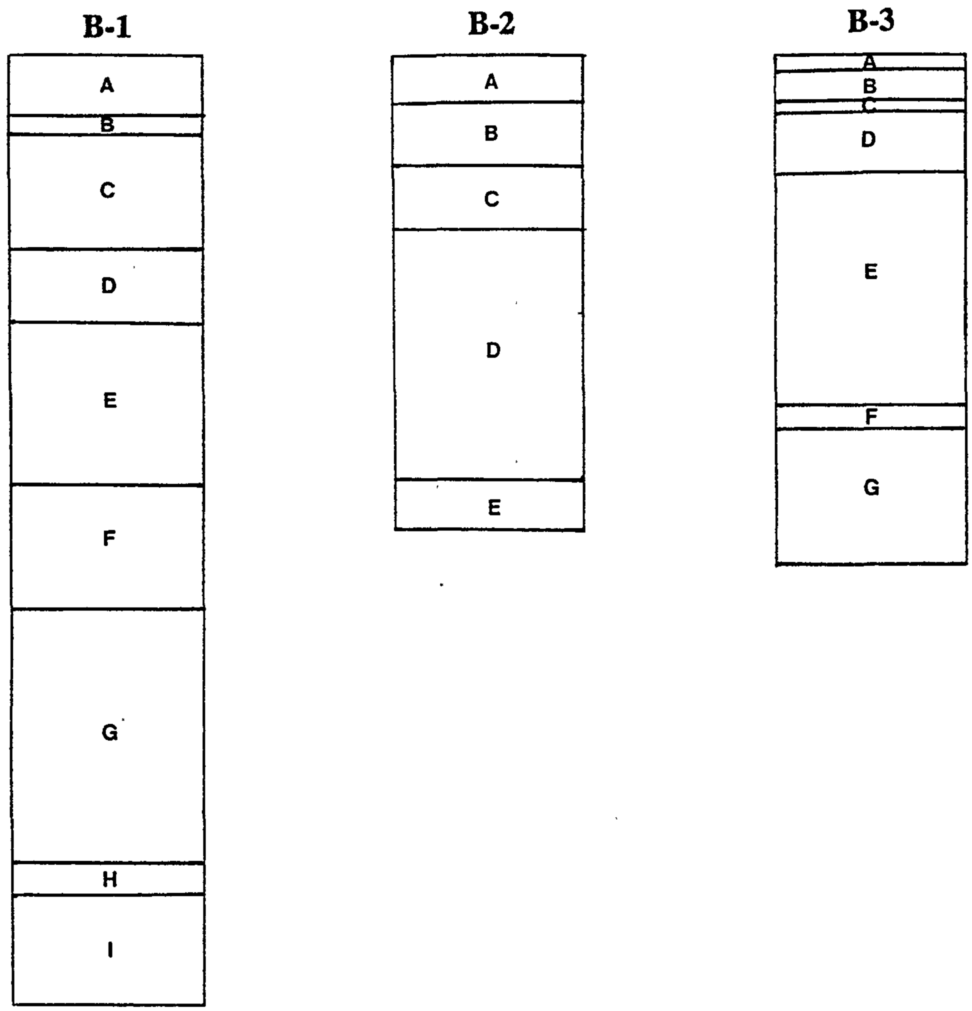
Stratum A:	Yellow grey brown silty loam (fill)
Stratum B:	Coarse orange brown sand with gravel (fill)
Stratum C:	Loose wet brownish yellow silty sand (fill)
Stratum D:	Black gritty sand (fill)
Stratum E:	Yellow brown silty coarse sand (fill)
Stratum F:	Greyish brown sandy silt with brick fragments and gravel (fill)
Stratum G:	Brick foundation
Notes:	*Approximately 2 feet of process-related organic material in tank.*



Source: Versar, Inc.

Dover Gas Light

Figure 22
Test Boring
Location Map



B-1

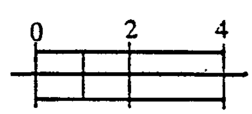
A: Tan grey sand (fill)
B: Dark grey sand with brick fragments (fill)
C: Orange brown sandy silt with brick fragments (fill)
D: Orange micaceous sand (fill)
E: Yellow brown micaceous sand (fill)
F: Orange brown sand (smells of petroleum)
G: Very dark grey silty sand with dark grey staining
H: Tan brown medium sandy clay
I: Bright orange coarse sand and gravel

B-2

A: Bright orange sand and gravel (fill)
B: Mixed yellow grey brown sand and medium gravels (fill)
C: Very coarse orange sand and gravel (fill)
D: Black burnt tar clinker and ash (fill)
E: Solid brick foundation (intact)

B-3

A: Yellow grey brown silty loam (fill)
B: Coarse orange brown sand with gravel (fill)
C: Loose wet brownish yellow silty sand (fill)
D: Black gritty sand (fill)
E: Yellow brown silty coarse sand (fill)
F: Greyish brown sandy silt with brick fragments and gravel (fill)
G: Brick foundation



Scale in Feet

Source: Engineering-Science

Dover Gas Light

Figure 23
Stratigraphic Profiles from Soil Borings B-1/B-3

B-4 *(Figure 24)*

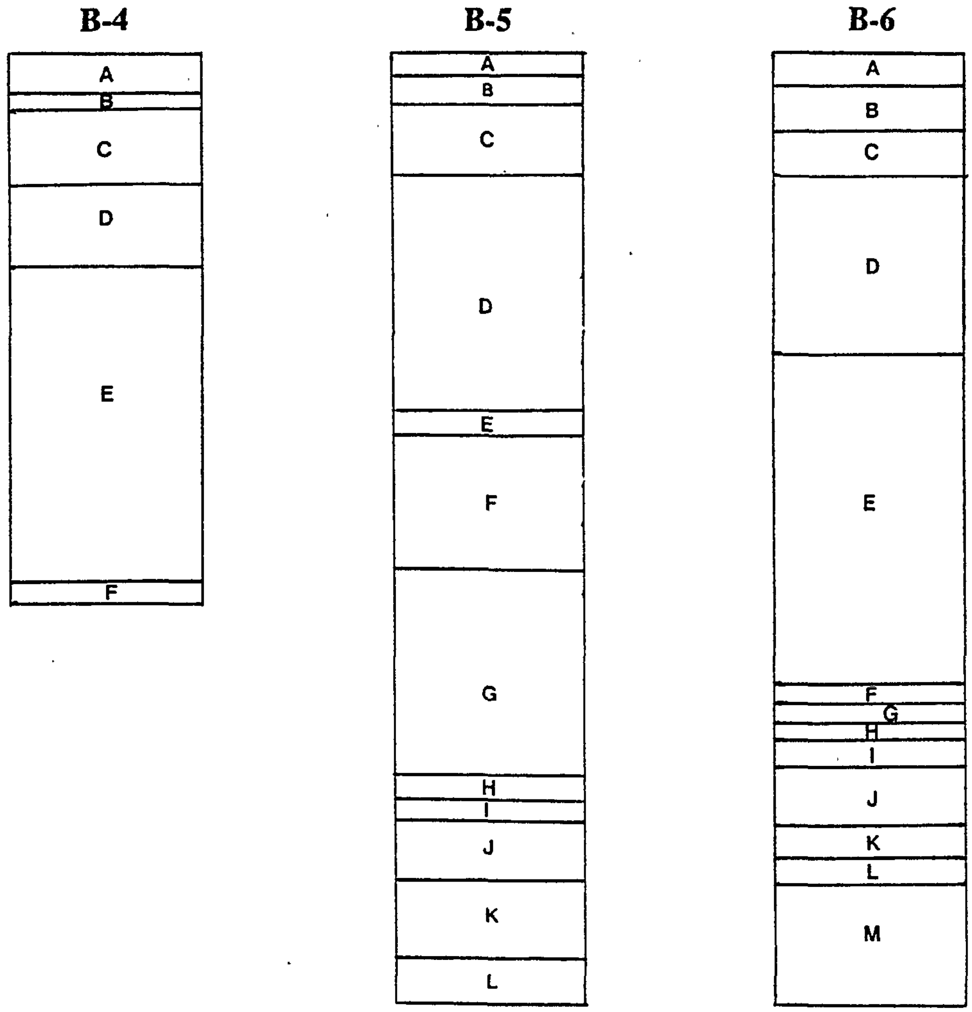
Stratum A:	Dark grey brown and black mottled silty sand (fill)
Stratum B:	Coarse orange sand and gravel (fill)
Stratum C:	Greyish brown silty sand and gravel (fill)
Stratum D:	Dark grey brown to black sandy silt with brick rubble (fill)
Stratum E:	Dark brown to black silty sand with rubble (fill)
Stratum F:	Solid brick foundation

B-5 *(Figure 24)*

Stratum A:	Light grey brown fine sand and gravel (fill)
Stratum B:	Orange sand and gravel (fill)
Stratum C:	Dark grey brown silty sand and gravel (fill)
Stratum D:	Light yellow brown sand (fill)
Stratum E:	Light greyish yellow sand (fill)
Stratum F:	Mottled orange brown sand (fill)
Stratum G:	Light grey brown sand with dark grey staining (fill)
Stratum H:	Very coarse black sand and gravel with black residue (fill)
Stratum I:	Dark grey brown plastic clay
Stratum J:	Dark brown silty sand and gravel
Stratum K:	Coarse orange sand and gravel
Stratum L:	Black coarse sand

B-6 *(Figure 24)*

Stratum A:	Orange brown sand and gravel (fill)
Stratum B:	Dark grey brown sandy silt with brick (fill)
Stratum C:	Orange brown coarse silty sand (fill)
Stratum D:	Yellow and orange medium sand
Stratum E:	Mottled orange sand
Stratum F:	Grey and purple mottled silty clay
Stratum G:	Fine bright orange sand
Stratum H:	Yellow brown sandy clay mottled with orange
Stratum I:	Bright orange silty sand
Stratum J:	Orange brown silty sand with gravel
Stratum K:	Very fine orange brown sand
Stratum L:	Very coarse mottled orange brown sand
Stratum M:	Medium orange sand
Notes:	*Relatively clean boring; water table encountered at c. 12 feet*



B-4

A: Dark grey brown and black mottled silty sand (fill)

B: Coarse orange sand and gravel (fill)

C: Greyish brown silty sand and gravel (fill)

D: Dark grey brown to black sandy silt with brick rubble (fill)

E: Dark brown to black silty sand with rubble (fill)

F: Solid brick foundation

B-5

A: Light grey brown fine sand and gravel (fill)

B: Orange sand and gravel (fill)

C: Dark grey brown silty sand and gravel (fill)

D: Light yellow brown sand (fill)

E: Light greyish yellow sand (fill)

F: Mottled orange brown sand (fill)

G: Light grey brown sand with dark grey staining (fill)

H: Very coarse black sand and gravel with black residue (fill)

I: Dark grey brown plastic clay

J: Dark brown silty sand and gravel

K: Coarse orange sand and gravel

L: Black coarse sand

B-6

A: Orange brown sand and gravel (fill)

B: Dark grey brown sandy silt with brick (fill)

C: Orange brown coarse silty sand (fill)

D: Yellow and orange medium sand

E: Mottled orange sand

F: Grey and purple mottled silty clay

G: Fine bright orange sand

H: Yellow brown sandy clay mottled with orange

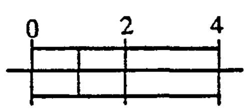
I: Bright orange silty sand

J: Orange brown silty sand with gravel

K: Very fine orange brown sand

L: Very coarse mottled orange brown sand

M: Medium orange sand



Scale in Feet

Source: Engineering-Science

Dover Gas Light

AR308506

Figure 24
Stratigraphic Profiles from Soil Borings B-4/B-6

B-7 *(Figure 25)*

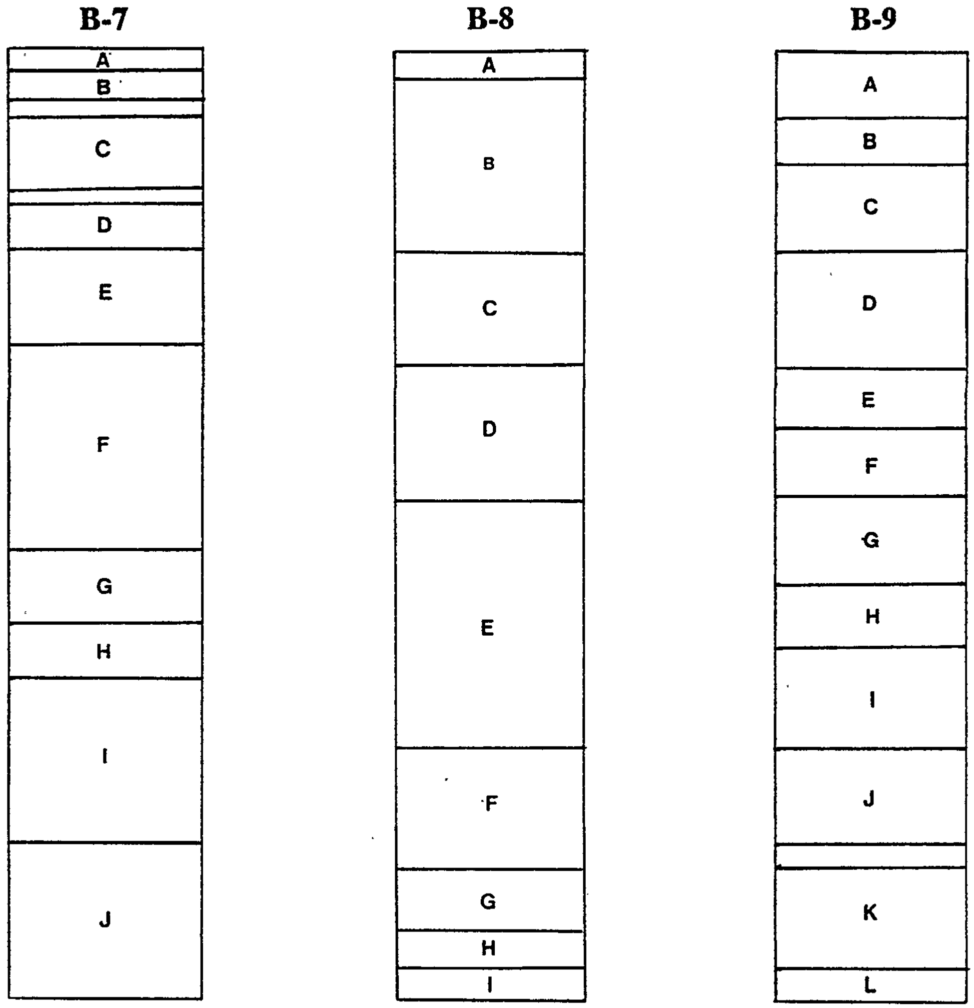
Stratum A:	Asphalt and gravel with coke (fill)
Stratum B:	Orange sand and gravel with coke (fill)
Stratum C:	Medium brown silty sand with coke (fill)
Stratum D:	Orange sand (fill)
Stratum E:	Tan sand with gravel and coke (fill)
Stratum F:	Light orange to yellow sand with iron concretions
Stratum G:	Yellowish white coarse sand with gravel
Stratum H:	Dark greyish brown clay-sand with gravel
Stratum I:	Bright orange very coarse sand and gravel
Stratum J:	Coarse orange sand mottled with brown sand
Notes:	*Water table encountered at c. 11 feet; asphalt between Strata B & C and C & D; terra cotta pipe fragments at the interface of Strata C and D; Stratum B contains one fragment of undecorated whiteware*

B-8 *(Figure 25)*

Stratum A:	Dark yellow brown humic sandy silt (fill)
Stratum B:	Coarse orange silty sand with coal fragments (fill)
Stratum C:	Mottled orange sand and brownish grey sand clay with coal fragments (fill)
Stratum D:	Very fine yellowish-orange micaceous sand (fill)
Stratum E:	Brownish orange medium sand with iron concretions
Stratum F:	Brownish yellow medium to coarse sand with dark brown staining
Stratum G:	Coarse yellow and white sand and gravel
Stratum H:	Grey black very coarse sand
Stratum I:	Coarse orange sand and gravel with iron concretions

B-9 *(Figure 25)*

Stratum A:	Orange sand and gravel (fill)
Stratum B:	Black asphalt (fill)
Stratum C:	Brownish grey sandy silt with asphalt (fill)
Stratum D:	Light orange silty micaceous sand with asphalt (fill)
Stratum E:	Dark grey silty sand with asphalt (fill)
Stratum F:	Dark brown silty fine sand (fill)
Stratum G:	Tan sand (fill)
Stratum H:	Reddish brown sand (fill)
Stratum I:	Greyish brown sand (fill)
Stratum J:	Yellowish grey silty sand (fill)
Stratum K:	Yellowish silty wet sand
Stratum L:	Bright orange sand with fine gravel
Notes:	*Water table encountered at c. 14 feet*



B-7

A: Asphalt and gravel with coke (fill)

B: Orange sand and gravel with coke (fill)

C: Medium brown silty sand with coke (fill)

D: Orange sand (fill)

E: Tan sand with gravel and coke (fill)

F: Light orange to yellow sand with iron concretions

G: Yellowish white coarse sand with gravel

H: Dark greyish brown clay-sand with gravel

I: Bright orange very coarse sand and gravel

J: Coarse orange sand mottled with brown sand

B-8

A: Dark yellow brown humic sandy silt (fill)

B: Coarse orange silty sand with coal fragments (fill)

C: Mottled orange sand and brownish grey sand clay with coal fragments (fill)

D: Very fine yellowish-orange micaceous sand (fill)

E: Brownish orange medium sand with iron concretions

F: Brownish yellow medium to coarse sand with dark brown staining

G: Coarse yellow and white sand and gravel

H: Grey black very coarse sand

I: Coarse orange sand and gravel with iron concretions

B-9

A: Orange sand and gravel (fill)

B: Black asphalt (fill)

C: Brownish grey sandy silt with asphalt (fill)

D: Light orange silty micaceous sand with asphalt (fill)

E: Dark grey silty sand with asphalt (fill)

F: Dark brown silty fine sand (fill)

G: Tan sand (fill)

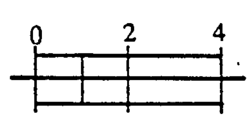
H: Reddish brown sand (fill)

I: Greyish brown sand (fill)

J: Yellowish grey silty sand (fill)

K: Yellowish silty wet sand

L: Bright orange sand with fine gravel



Source: Engineering-Science

Dover Gas Light

Figure 25
Stratigraphic Profiles
from Soil Borings B-7/B-9

B-10 *(Figure 26)*

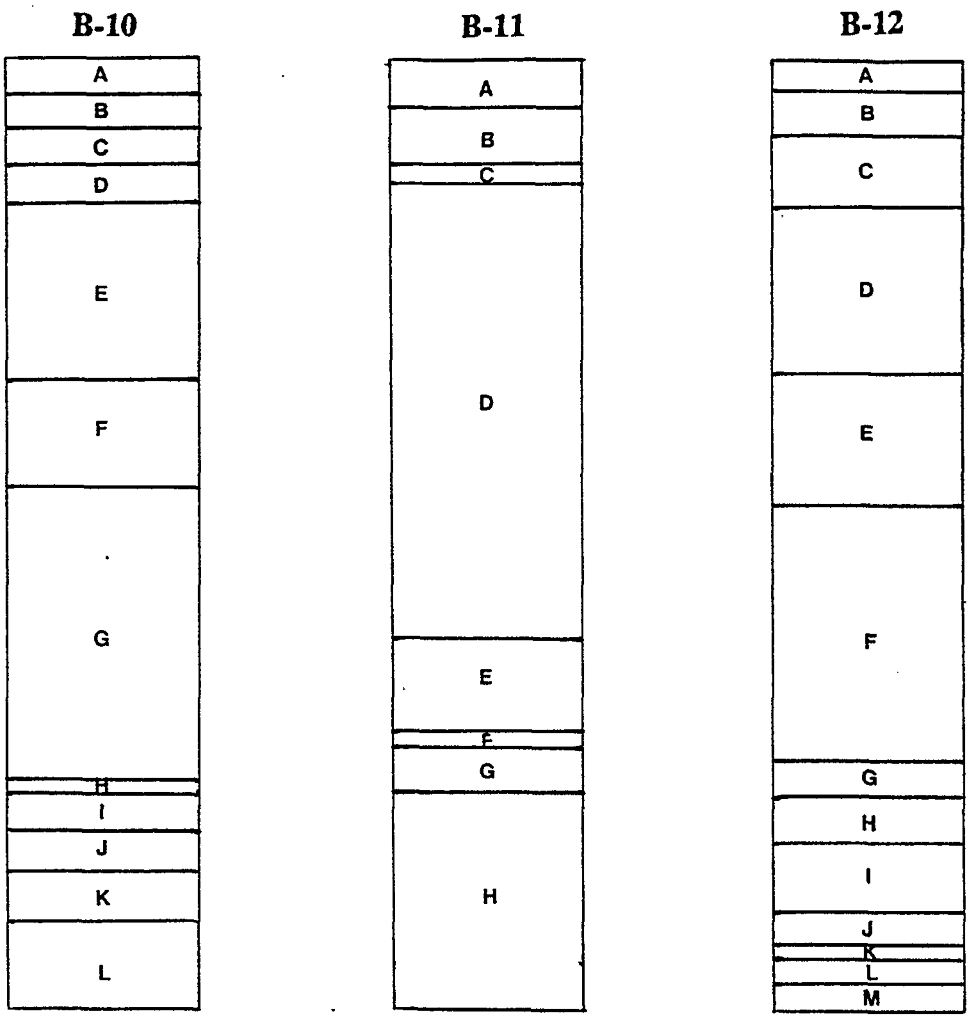
Stratum A:	Dark grey brown sand and gravel (fill)
Stratum B:	Coarse orange brown sand and gravel (fill)
Stratum C:	Very dark grey brown silty sand and gravel with cement and brick rubble (fill)
Stratum D:	Yellow and orange very hard-packed sandy silt with cement and brick rubble (fill)
Stratum E:	Light yellow grey silty sand with cement and brick rubble (fill)
Stratum F:	Yellow brown medium sand with grey staining
Stratum G:	Yellowish grey and medium grey sandy silt
Stratum H:	Dark brown coarse sand and gravel (oily)
Stratum I:	Mottled grey brown and orange brown clay
Stratum J:	Mottled orange silty clay with brown silty clay
Stratum K:	Yellow brown silty sand
Stratum L:	Bright orange sand and gravel
Notes:	*Water table encountered at c. 11 feet*

B-11 *(Figure 26)*

Stratum A:	Orange brown sand and gravel with coal and brick fragments(fill)
Stratum B:	Black grit with coal and brick fragments (fill)
Stratum C:	Dark grey coarse sand (fill)
Stratum D:	Greyish brown medium sand
Stratum E:	Yellowish brown silty sand
Stratum F:	Fine black gravel
Stratum G:	Brownish grey plastic silty clay
Stratum H:	Yellow brown mottled silty sand
Notes:	*Water table encountered at c. 12 feet*

B-12 *(Figure 26)*

Stratum A:	Orange and brown coarse sand and gravel (fill)
Stratum B:	Very dark brown silty sand with gravel and brick fragments (fill)
Stratum C:	Yellowish grey brown sandy silt with gravel and brick fragments (fill)
Stratum D:	Yellowish grey sand with brick fragments and mortar (fill)
Stratum E:	Very light grey sand
Stratum F:	Light grey silty sand with gravel
Stratum G:	Grey brown mottled silty clay with lenses of decayed ironstone
Stratum H:	Grey and orange mottled clay
Stratum I:	Light grey fine silty sand
Stratum J:	Medium grey silty sand
Stratum K:	Coarse orange sand and gravel
Stratum L:	Black coarse sand and gravel
Stratum M:	Coarse orange sand
Notes:	*Water table encountered at c. 12 feet*



B-10

A: Dark grey brown sand and gravel (fill)

B: Coarse orange brown sand and gravel (fill)

C: Very dark grey brown silty sand and gravel with cement and brick rubble (fill)

D: Yellow and orange very hard-packed sandy silt with cement and brick rubble (fill)

E: Light yellow grey silty sand with cement and brick rubble (fill)

F: Yellow brown medium sand with grey staining

G: Yellowish grey and medium grey sandy silt

H: Dark brown coarse sand and gravel (oily)

I: Mottled grey brown and orange brown clay

J: Mottled orange silty clay with brown silty clay

K: Yellow brown silty sand

L: Bright orange sand and gravel

B-11

A: Orange brown sand and gravel with coal and brick fragments(fill)

B: Black grit with coal and brick fragments (fill)

C: Dark grey coarse sand (fill)

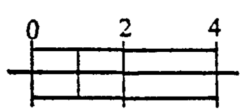
D: Greyish brown medium sand

E: Yellowish brown silty sand

F: Fine black gravel

G: Brownish grey plastic silty clay

H: Yellow brown mottled silty sand



Scale in Feet

B-12

A: Orange and brown coarse sand and gravel (fill)

B: Very dark brown silty sand with gravel and brick fragments (fill)

C: Yellowish grey brown sandy silt with gravel and brick fragments (fill)

D: Yellowish grey sand with brick fragments and mortar (fill)

E: Very light grey sand

F: Light grey silty sand with gravel

G: Grey brown mottled silty clay with lenses of decayed ironstone

H: Grey and orange mottled clay

I: Light grey fine silty sand

J: Medium grey silty sand

K: Coarse orange sand and gravel

L: Black coarse sand and gravel

M: Coarse orange sand

Source: Engineering-Science

Figure 26
Stratigraphic Profiles
from Soil Borings B-10/B-12

B-13 *(Figure 27)*

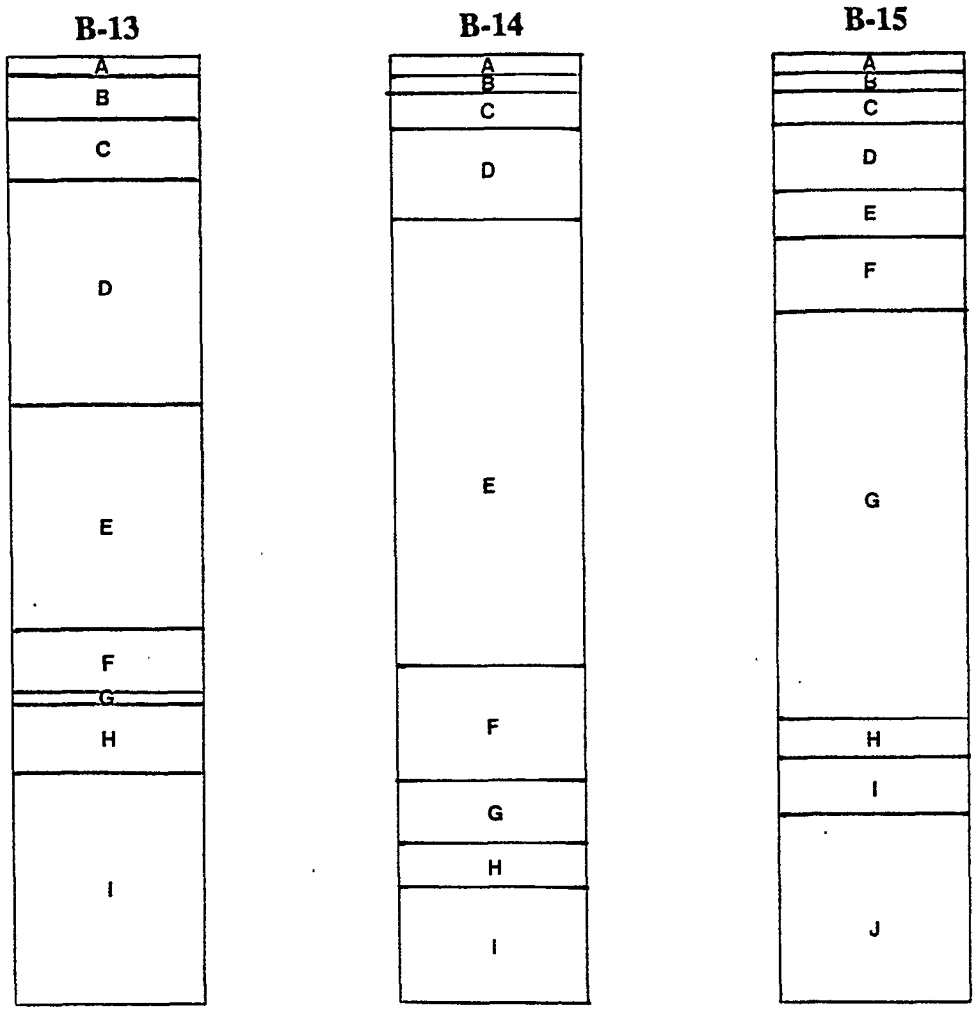
Stratum A:	Yellow brown (dark humic) sandy silt with brick fragments (fill)
Stratum B:	Brownish orange sand with gravel, brick and cinder (fill)
Stratum C:	Very dark brown and black ash mottled with black and orange silty sand (fill)
Stratum D:	Bright orange fine micaceous sand and gravel (fill)
Stratum E:	Coarse yellow orange sand
Stratum F:	Yellow brown coarse sand
Stratum G:	Compact grey brown compact sand
Stratum H:	Orange brown slightly silty clay
Stratum I:	Very coarse orange sand and fine gravel
Notes:	*Water table encountered at c. 12 feet*

B-14 *(Figure 27)*

Stratum A:	Dark greyish brown coarse sand and gravel with brick fragments (fill)
Stratum B:	Bright orange coarse sand and gravel with brick fragments (fill)
Stratum C:	Dark brown coarse sand and gravel (fill)
Stratum D:	Dark grey brown silty sand and gravel (fill)
Stratum E:	Orange brown silty sand
Stratum F:	Yellow brown sand
Stratum G:	Light grey silty clay
Stratum H:	Greyish brown sand
Stratum I:	Orange brown sand
Notes:	*Water table encountered at c. 14 feet*

B-15 *(Figure 27)*

Stratum A:	Dark brown sand and gravel with brick fragments, clinker, wood(fill)
Stratum B:	Bright orange sand and medium pea size gravel with brick fragments, clinker, wood (fill)
Stratum C:	Dark grey silty sand with brick and gravel with brick fragments, clinker, wood (fill)
Stratum D:	Black gravel tar and coal lense with brick fragments, clinker, wood (fill)
Stratum E:	Yellowish grey (stained) silty sand with brick fragments, clinker, wood(fill)
Stratum F:	Mottled grey and red brown silty sand (fill)
Stratum G:	Red brown silty sand with patches of grey brown sand
Stratum H:	Semi plastic silty greyish yellow clay
Stratum I:	Brownish yellow silty clay
Stratum J:	Brownish orange coarse sand
Notes:	*Water table encountered at c. 12 feet; rope found at interface of Strata F and G*



B-13

A: Yellow brown (dark humic) sandy silt with brick fragments (fill)

B: Brownish orange sand with gravel, brick and cinder (fill)

C: Very dark brown and black ash mottled with black and orange silty sand (fill)

D: Bright orange fine micaceous sand and gravel (fill)

E: Coarse yellow orange sand

F: Yellow brown coarse sand

G: Compact grey brown compact sand

H: Orange brown slightly silty clay

I: Very coarse orange sand and fine gravel

B-14

A: Dark greyish brown coarse sand and gravel with brick fragments (fill)

B: Bright orange coarse sand and gravel with brick fragments (fill)

C: Dark brown coarse sand and gravel (fill)

D: Dark grey brown silty sand and gravel (fill)

E: Orange brown silty sand

F: Yellow brown sand

G: Light grey silty clay

H: Greyish brown sand

I: Orange brown sand

B-15

A: Dark brown sand and gravel with brick fragments, clinker, wood(fill)

B: Bright orange sand and medium pea size gravel with brick fragments, clinker, wood (fill)

C: Dark grey silty sand with brick and gravel with brick fragments, clinker, wood (fill)

D: Black gravel tar and coal lense with brick fragments, clinker, wood (fill)

E: Yellowish grey (stained) silty sand with brick fragments, clinker, wood (fill)

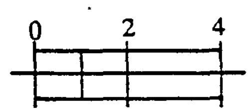
F: Mottled grey and red brown silty sand (fill)

G: Red brown silty sand with patches of grey brown sand

H: Semi-plastic silty greyish yellow clay

I: Brownish yellow silty clay

J: Brownish orange coarse sand



Scale in Feet

Source: Engineering-Science

Dover Gas Light

AR308512

Figure 27
Stratigraphic Profiles
from Soil Borings B-13/B-15

B-16 *(Figure* 28)

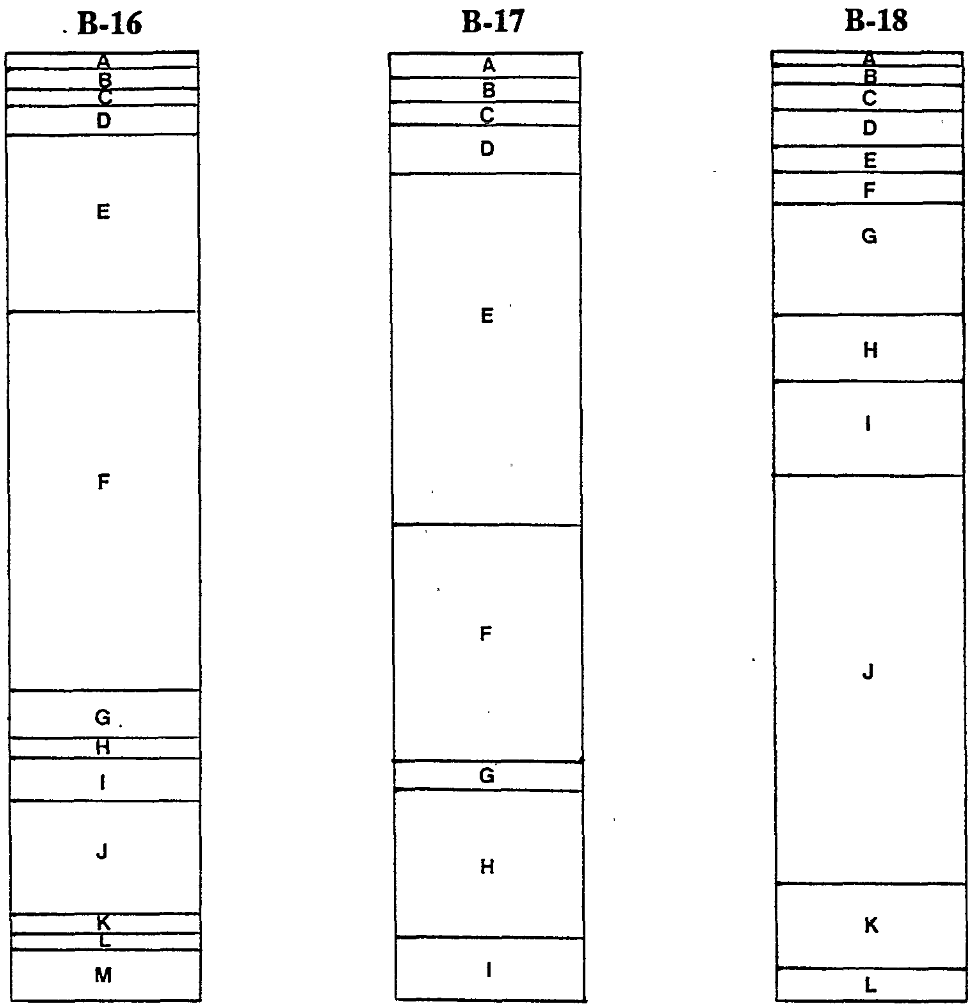
Stratum A:	Bright orange coarse sand with gravel (fill)
Stratum B:	Black gritty sand with asphalt (fill)
Stratum C:	Bright orange sand with coal slag (fill)
Stratum D:	Dark greyish brown sandy silt (fill)
Stratum E:	Orange brown medium sand and gravel
Stratum F:	Yellow orange fine sand with grit and gravel
Stratum G:	Coarse yellow brown sand and gravel
Stratum H:	Black gravel and coarse oily sand
Stratum I:	Dark brownish grey clay
Stratum J:	Coarse yellow brown sand and gravel
Stratum K:	Medium sand and gravel with brown staining
Stratum L:	Black decayed stone and sand
Stratum M:	Bright orange coarse sand with iron concretions
Notes:	*Water table encountered at c. 11 feet*

B-17 *(Figure 28)*

Stratum A:	Orange coarse sand and gravel (fill)
Stratum B:	Very dark grey and black sand and asphalt with pitch, ash and brick fragments (fill)
Stratum C:	Light greyish clinker and fine sand with ash (fill)
Stratum D:	Dark reddish brown sandy silt (fill)
Stratum E:	Medium brown sand mottled with grey and black (fill)
Stratum F:	Coarse tan sand with black staining
Stratum G:	Coarse yellow very oily sand with gravel
Stratum H:	Coarse sandy clay with gravel
Stratum I:	Coarse orange sand and gravel
Notes:	*Water table encountered at c. 12 feet*

B-18 *(Figure 28)*

Stratum A:	Yellow brown sand and gravel (fill)
Stratum B:	Orange sand and gravel (fill)
Stratum C:	Dark grey sand (fill)
Stratum D:	Yellow brown sand (fill)
Stratum E:	Dark brown silty sand (fill)
Stratum F:	Orange sand (fill)
Stratum G:	Mottled yellow and white sand (fill)
Stratum H:	Yellowish grey sand (fill)
Stratum I:	Orange and grey sand (fill)
Stratum J:	Grey sand
Stratum K:	Bright orange sand and iron concretions
Stratum L:	Yellow claylike sand with gravel



B-16

A: Bright orange coarse sand with gravel (fill)

B: Black gritty sand with asphalt (fill)

C: Bright orange sand with coal slag (fill)

D: Dark greyish brown sandy silt (fill)

E: Orange brown medium sand and gravel

F: Yellow orange fine sand with grit and gravel

G: Coarse yellow brown sand and gravel

H: Black gravel and coarse oily sand

I: Dark brownish grey clay

J: Coarse yellow brown sand and gravel

K: Medium sand and gravel with brown staining

L: Black decayed stone and sand

M: Bright orange coarse sand with iron concretions

B-17

A: Orange coarse sand and gravel (fill)

B: Very dark grey and black sand and asphalt with pitch, ash and brick fragments (fill)

C: Light greyish clinker and fine sand with ash (fill)

D: Dark reddish brown sandy silt (fill)

E: Medium brown sand mottled with grey and black (fill)

F: Coarse tan sand with black staining

G: Coarse yellow very oily sand with gravel

H: Coarse sandy clay with gravel

I: Coarse orange sand and gravel

B-18

A: Yellow brown sand and gravel (fill)

B: Orange sand and gravel (fill)

C: Dark grey sand (fill)

D: Yellow brown sand (fill)

E: Dark brown silty sand (fill)

F: Orange sand (fill)

G: Mottled yellow and white sand (fill)

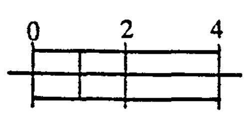
H: Yellowish grey sand (fill)

I: Orange and grey sand (fill)

J: Grey sand

K: Bright orange sand and iron concretions

L: Yellow claylike sand with gravel



Scale in Feet

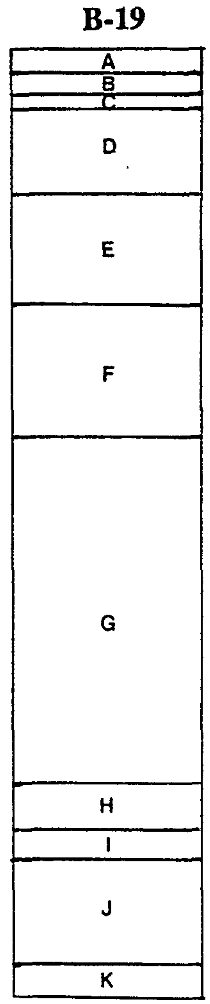
Source: Engineering-Science

Dover Gas Light

Figure 28
Stratigraphic Profiles
from Soil Borings B-16/B-18

3-19 *(Figure 29)*

Stratum A:	Dark brown gritty sand with gravel (fill)
Stratum B:	Orange sand and gravel (fill)
Stratum C:	Dark grey silt with gravel with brick fragments (fill)
Stratum D:	Greyish brown silt with brick fragments (fill)
Stratum E:	Light orange brown micaceous silty sand with coal (fill)
Stratum F:	Mottled yellow brown sand
Stratum G:	Grey sand
Stratum H:	Tan-orange sand with iron concretions
Stratum I:	Orange sandy clay and gravel
Stratum J:	Light yellow coarse sand and fine gravel
Stratum K:	Bright orange coarse sand and gravel with iron concretions
Notes:	*Water table encountered at c. 12 feet*



A: Dark brown gritty sand with gravel (fill)

B: Orange sand and gravel (fill)

C: Dark grey silt with gravel with brick fragments (fill)

D: Greyish brown silt with brick fragments (fill)

E: Light orange brown micaceous silty sand with coal (fill)

F: Mottled yellow brown sand

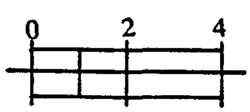
G: Grey sand

H: Tan-orange sand with iron concretions

I: Orange sandy clay and gravel

J: Light yellow coarse sand and fine gravel

K: Bright orange coarse sand and gravel with iron concretions



Scale in Feet

Source: Engineering-Science

Dover Gas Light

Figure 29
Stratigraphic Profile from Soil Boring B-19

VIII. SUMMARY OF FINDINGS

A. Historical Documentation

This Phase IA/IIA study presents the history of land use of the former manufactured gas plant. Title research traces the initial ownership of the land from 1729. In the 1840s, the site was part of a 4-acre plot. A house was located on this plot by the 1840s and was tenanted by a free African-American, John Harris. In 1856, another African-American, Caleb Spearman, lived in a house on this plot. Archival research did not yield the actual location of this house on the plot, nor whether the second tenant occupied the same house as the first. The project area is 1.24 acres of the 4-acre plot upon which the Harris house was located. It is likely that his house would have been located closer to the African-American community west of the project area, and closer to Meeting House or Tar Branch. In addition, historic maps illustrate that most homes fronted on North Street. Bank Lane and New Street had not been cut through in the 1840s. It is likely that this house also would have fronted on North Street.

The gas works began production in 1859. Daniel Trump initially purchased the land and it appears that a probable relative, Charles M. Trump, was also involved with the operation. At this time the plant produced gas from resin. The plant encountered financial difficulties in the first years of production and was abandoned by the Trumps in 1866. The abandonment may have been due to economic hardship caused by the Civil War, mechanical difficulties, poor business practice, or a combination thereof.

In 1867, the plant was purchased by Richardson and Robbins, who owned a local cannery. They supplied gas for street lighting as well as for homes and a few businesses. Although Richardson and Robbins initially produced gas from resin, by 1869 they had converted to the coal gas process and production continued in the retort house.

Richardson and Robbins insured a house on the northwest corner of the property in 1875. The house was tenanted by Peter Moore, who was known to have worked at the plant from 1881 to 1883. The 1870 census lists a Peter Moore as a black man who lived with his wife and three children. This is likely to be the same Peter Moore who occupied the residence at the plant.

In 1881 the Dover Gas Light Company was incorporated. Cash books and ledgers provide some information on the supplies used, employees and their wages, and customers. Production statistics published in a contemporary trade journal indicate that the company operated on a scale slightly greater than that of a plant in New Castle. The Dover manufactured gas plant's annual output was estimated at 6,600,000 c.f. in 1899, with 400 customers, and 20 percent for fuel purposes (Brown 1899:75). It was much smaller than the gas plant in Wilmington, which served a larger and more industrialized area, with an annual output estimated at 172,000,000 c.f., 6,764 customers, and 22 percent for fuel.

By 1910, the Dover Gas Light Company had converted to the carbureted water-gas process of manufacture and the equipment was housed in a newer processing building slightly to the south of the original location. This process had been invented in 1875 and was the predominant method of production in the twentieth century. Late nineteenth- and early twentieth-century maps indicate the improvements made to the property during this period. The processing building was enlarged, and the smaller gasholders replaced by larger ones, including 20,000- and 100,000-cubic-foot-capacity gasholders. Oil tanks replaced the coal storage bins, and the site was more intensively utilized. The original retort building was used for storage. The dwelling on the northwest corner of the property was removed between 1910 and 1919.

By 1910, the former Dover Gas Light site had increased to more than one acre in size, its property extending south to Bank Lane. The additional land also had been part of the 4-acre parcel which was subdivided in the 1840s. At the time this additional land was purchased there were five double two-story houses located there. They had been on this property at least as early as 1899 (Kent County Orphans Court Book L-2:416). These houses were demolished sometime between 1911 and 1919 (Sanborn) when additional expansion to the plant occurred.

During the period from the 1920s to the 1940s, the demand for manufactured gas decreased as the availability of electricity and natural gas became more prevalent. In 1949, the gas plant was closed.

By 1950, all of the buildings on site had been demolished with the exception of the original retort building. The retort building was refitted by the Delaware State Museum to store heavy exhibits until the mid-1980s, and became known as Museum Building No. 3. It was destroyed by fire in 1985, dismantled, and removed from the site for disposal several years later. This structure had no basement.

In 1954, it was proposed that a garden plot be constructed in the area to the south of Museum Building Number 3. A letter from the Director of the Delaware State Museum to Mr. G.P. Ward, City Manager, dated November 9, 1954, describes the plan for garden construction. The letter indicated that in the area of the garden, up to twenty inches of demolition debris was removed and replaced with "sweet soil".

The remaining grounds of the former gas plant were modified in order to use the area for automobile parking. A lease dated November 13, 1955 between the Public Archives Commission and the Dover Parking Authority presents the plan to make the property suitable for a parking lot. Article II of the lease indicated that the Parking Authority agreed to grade the entire lot except for the aforementioned garden plot and the space occupied by the State Museum Building No. 3. This grading would have, in all likelihood, removed any sheet refuse associated with the site. Grading on the property ranged from a few inches to more than two feet.

In 1967, the Johnson Building was constructed on the southern portion of the site, near the corner of New Street and Bank Lane. This construction would have impacted archaeological resources in this location.

B. Remote Sensing and Soil Borings

The geophysical survey, monitored by an archaeologist, was conducted to determine the presence of any subsurface archaeological features. The methods used were Electromagnetometry (EM) and Ground Penetrating Radar (GPR).

An analysis of the findings of the geophysical survey, indicated the presence of anomalies, some of which correspond with the former locations of known structural features. In the northwest corner, an anomaly corresponds with the former location of a dwelling. Other anomalies appear in the former location of the main structure and where several of the gas holders were located. The identification of a demolished brick building (original retort structure) is based on presence of brick rubble on the ground surface. For more complete information on this study, see Appendix B - Geophysical Survey.

The purpose of the soil boring survey was to determine on-site characteristics. An archaeologist, present on site during the soil borings, examined the findings relative to predictions of cultural features remaining below ground. An examination of the soil borings reveals the presence of fill at depths from 2 to 15 feet across the site. The borings also confirm the general prediction that the intense industrial use of the property during the nineteenth and twentieth century has affected the original soil stratigraphy. The original nineteenth century ground surface may have been between two and five feet below existing elevation (Borings B-16, B-6, B-19). Some of the structures on the site had deep foundations, or required excavation prior to installation of the necessary industrial features.

Soil boring B-1 was drilled in the interior of the original retort house where, according to historical documentation, a coke furnace once was located. No evidence of this furnace was discovered. Soil and brick rubble were encountered to a depth of nine feet. The building reportedly did not have a basement. Because this building was abandoned early in the twentieth century, the furnace, retort ovens, and other equipment were undoubtedly removed.

Soil boring B-2 intercepted the brick base of a gasholder at a depth of ten feet. This gas holder appears on the Sanborn map of 1885. Soil boring B-3 intercepted the base of a gasholder at 12 feet below surface. This gas holder is also illustrated on the 1885 Sanborn map. Soil boring B-4 intercepted the brick base of a gasholder at a depth of twelve feet. This gas holder is illustrated on the 1897 Sanborn map.

It was anticipated that soil boring B-5 would intercept the largest gasholder which appears on the 1919 and 1929 Sanborn maps. This soil boring was drilled to a depth of twenty feet with no indication of the presence of a gasholder. At 1-1/2 feet, a 4 inch concrete slab was found. The absence of a brick or stone foundation for a gasholder indicates that the structure was removed, and the hole was filled.

Soil boring B-7 was drilled in the southeast corner of the site where one of the double two-story houses and later, a tar tank, were located. There was no evidence of any intact structural remains associated with the house or the tar tank. Below asphalt layers at 1-1/2 feet and 3 feet, there was evidence of rubble and piping.

Soil borings B-10, B-11 and B-12 were drilled in the interior of the newer processing and generating building (often referred to as the main building). B-10 and B-12 were in the oldest section of the structure, while B-11 was located in a newer addition, dating from the 1910 to 1919 period. Oral tradition indicates that this structure was demolished and that demolition rubble may have been used to infill the basement. The presence of brick rubble in these three borings appears to support this conclusion. It is possible some subsurface remains of the basement structure may still be relatively intact, including foundation walls. The structure was built in several phases, however, and not all additions may have had cellars or basements. Equipment was probably removed prior to demolition. Therefore the basement remains are not expected to reveal significant information related to gas works operation.

Soil borings B-9, B-18 and B-19 were all drilled in the northeast corner of the site. This area contained deep fill and evidence of asphalt. In B-19, there was fill to 5-1/2 feet, and coal fragments and rubble were found.

No borings were placed within the area of the old dwelling house (ca. 1885 - 1919) because contaminants were not anticipated to be present in this location. It should be noted, however, that an anomaly was detected in the location of the house by the geophysical survey.

The findings of the historical research analyzed in combination with the soil borings and the results of the geophysical survey indicated that structural remains and other subsurface features associated with the gas plant and the dwellings may be present archaeologically. Historical documentation suggests that grading which occurred as a result of the construction of a garden plot and the parking lot would have impacted archaeological surface deposits. The area of the garden to the south of Museum Building 3 (the former retort house) was graded 20 inches. In the parking area, grading ranged from a few inches to 2 feet 8 inches. This grading, in all likelihood, would have destroyed any sheet refuse which may have accumulated on the surface. Since some degree of grading occurred in all areas where buildings were not present, surface deposits are not anticipated. Since grading activities only removed up to 2 feet, 8 inches, features which extended below this depth would remain.

IX. PREDICTIVE MODEL AND RESOURCE EXPECTATIONS

This Phase IA/IIA study presents the history of land use at the Dover Gas Light site; a summary of information regarding the plant's management, operation and closure; and a history of gas manufacturing industry, technology and processes. The results of a geophysical survey and soil borings on-site have also been presented. The findings of these studies form the basis of a predictive model for potential archaeological resources on the site. The predictive model has been developed using the Delaware State Historic Preservation Plan as a guide (Ames *et al.* 1989). This chapter presents the predictive model and resource expectations. Appropriate research questions have been formulated which may be answered through archaeological investigation.

A. Historic Period

Potential archaeological resources which may be present on the Dover Gas Light site would probably be associated with the former gas manufacturing facility and/or the dwellings which once stood on the site.

1. Former Dover Gas Light Manufactured Gas Plant

The significance of the predicted archaeological remains of the former gas manufacturing plant have been evaluated according to the State Plan. The growth and evolution of the plant corresponds to two historic periods: *Industrialization and Early Urbanization* (1830-1880+/-) and *Urbanization and Early Suburbanization* (1880-1940+/-).

During the period of *Industrialization and Early Urbanization*, Dover became the center of an expanding regional commercial and industrial economy as a result of the Delaware Railroad, the growth of the food processing and canning industry, and crop diversification in the surrounding region. During the period of *Urbanization and Early Suburbanization*, further improvements in transportation and technology as well as new employment opportunities (e.g., Dover Air Force Base, International Latex Corporation) increased suburbanization and slowly shifted the regional economy away from agriculture.

The former manufactured gas plant was most significant during the last half of the *Industrialization and Early Urbanization* period and first half of the *Urbanization and Early Suburbanization* period. The company was significant on a local level, for manufacturing and distributing the light and fuel for the streets, businesses, and residences in the city of Dover. However, its function as a fuel and lighting source for local industry, particularly canning and food processing, expanded its geographical influence beyond Dover. The industrial concerns which it supported improved the local economy by providing a market for local produce as well as employment opportunities. Furthermore, the goods produced were then distributed by railroad to larger urban centers, notably Baltimore, Wilmington and Philadelphia, which enabled Dover to participate in a wider regional economy.

The series of property types found in the State Plan categorizes "power production" under the heading of "government" with a subtheme of "public utilities." Although the Dover Gas works eventually came under public regulation, its period of greatest significance occurred under private ownership, and its importance relates to its role in technological and urban development rather than as a governmental service.

The former gas manufacturing plant most closely corresponds to the historic theme, "manufacturing" and the subtheme, "chemical production and processing." The plant was comprised of two categories of property types: storage and production. The storage facilities at the plant included structures to house the fuel necessary for the gasification process, such as coal sheds and oil tanks, and to contain the byproducts, such as gasholders and tar tanks. There were two production facilities, the retort building and the main processing building. These facilities were used during different time periods and were constructed for two different production processes. The original retort building was used for the coal carbonization process (also oil gas and resin gas). It contained the retort, exhauster, purifier, condenser, and metering equipment. These components were a functional unit and were housed together. The main processing building was used for the carbureted water-gas process. It included a room housing the distillation apparatus (generator, carburetor, and superheater), a boiler room and purifying room. During the mid-twentieth century, additional purifying structures were constructed outside of this building.

Findings from the geophysical survey indicated the presence of anomalies in the location of three of the former gasholders, and the former main gas manufacturing building. Locations of several other subsurface features, known to be historically present, were not detected in the geophysical survey, including two of the gasholders and the retort house.

The soil borings verified the presence of the gasholders identified in the historical research and detected through the geophysical survey. The locations of two other gasholders were indicated by the documentary research, although no anomalies were present in those areas during the geophysical survey. Soil boring data suggested that the gasholders at these locations may have been removed and the areas filled. Archaeological excavation could reveal the construction design.

The geophysical survey detected an anomaly in the location of the main processing building. Soil borings within this structure showed the presence of rubble which probably can be associated with the demolition of that structure. It is unclear whether the two-story main processing building had a basement. Additions were made to the building in 1910, 1919, and 1929. Archaeological excavation could possibly indicate changes and upgrades in the manufacturing process.

The retort house contained no basement or machinery associated with the manufacturing process. It would, however, have extended somewhat below grade. Remote sensing did not record any anomalies in the location of this building. Archaeology can verify whether subsurface remains of the building are present.

Depositions indicate that salvageable equipment was taken off-site prior to demolition. Nevertheless, any extant subsurface structural features from the property types of storage and production, as well as gas piping and fittings, if present, will provide information on the manufacturing process and the physical and cultural landscape of the plant. Such information has the potential to contribute data on construction design, spatial relations between and within structures, and the placement of equipment. Some of the artifacts associated with the gas plant may provide information on the trade networks of the gas light industry and indicate the adoption of technological improvements.

The model presented in the Delaware Management Plan proposes that the questions guiding industrial archaeology consider "the worker and the social and economic context of the industrial revolution as well as the processes of production and the evolution of technology" (DeCunzo and Catts 1990:145). The Dover Gas Light plant may provide the opportunity for such a study.

Historical research has provided information on marketing and the distribution of the product and the effect of gas lighting on the city of Dover and Delaware in general. Research and oral history interviews have provided information on the workforce stratification, responsibilities, work conditions, and ethnicity. Although unlikely, data may remain on the site which would indicate group behavior and where interactions took place.

2. Dwelling on North and New Streets

The dwelling located at the corner of North and New Streets falls into the historic periods of *Industrialization and Early Urbanization* and *Urbanization and Early Suburbanization*. It further fits into the historic theme of "settlement patterns and demographic change." The dwelling also may have been associated with the gas plant.

The geophysical survey indicated an anomaly in the location of the dwelling at the corner of North and New Streets. Archaeological testing could reveal the presence of foundations, outbuildings, wells, cisterns, privies, trash pits and/or other associated features.

Existing subsurface architectural features from the dwelling and associated outbuildings may provide information about the placement and components of an urban house site, evolution of land use, and alteration and meaning of the landscape.

Artifacts from wells and/or privies, if present, including ceramics, bottle glass, faunal remains such as bones and shells, and other artifacts will provide detail on an array of subjects. One important development during the late nineteenth and early twentieth centuries was the increasing consumer rather than producer orientation of individual household economies. Material remains may indicate this transition and provide an opportunity to examine local and regional trade networks and the operation of the nineteenth- and twentieth-century economy. In addition, the material remains will provide information on social and economic status, and subsistence patterns.

Finally, material remains may define how this structure was used by the gas plant employees.

3. Houses on Bank Lane

There were five double two-story houses located in the southern portion of the project area, three along Bank Lane and two along New Street. The first of these houses was constructed on Bank Lane adjacent to the Presbyterian Church cemetery by 1886, the remaining four were constructed by 1899. All of these houses were demolished by 1919. This property type corresponds with the historic period of *Urbanization and Early Suburbanization* and the historic theme of "settlement patterns and demographic change."

No evidence of any intact structural remains associated with one of the double two-story houses and the tar tank was found in the soil boring drilled in the southeast corner of the site.

These five dwellings were constructed by Jacob G. Lewis and were rented out to tenants. In 1900, the dwellings along Bank Lane were occupied by white working class families. Research to date has not revealed any association between these homes and the adjoining gas plant. The property they were located on was purchased by the Dover Gas Light Company in 1910 and the houses were demolished between 1911 and 1919. Archaeological resources associated with these dwellings would have been affected during the construction of the Johnson Building in 1966.

Existing subsurface architectural features from the dwellings and associated features, if present, may provide information about the placement and components of an urban house site and late nineteenth-century urban settlement patterns.

Artifacts from wells and/or privies, if present, including ceramics, bottle glass, faunal remains such as bones and shell, and other artifacts will provide detail on an array of subjects. One important development during the late nineteenth and early twentieth centuries, particularly in urban areas, was the increasing consumer rather than producer orientation of individual household economies. Material remains may indicate this transition and provide an opportunity to examine local and regional trade networks and the operation of the nineteenth- and twentieth-century economy. In addition, the material remains may provide information on social and economic status, and subsistence patterns.

4. John Harris House

The earliest dwelling potentially present on the site is the 1840s residence of the free African-American, John Harris. This dwelling fits into the period of *Industrialization and Early Urbanization* and the historic theme of "settlement patterns and demographic change."

There is a low probability that Mr. Harris' house was located within the project area. The project area comprises only 1.24 acres of the 4 acres 18 perches upon which the Harris house was located. In addition, it is likely that his house would have been located closer to the African-American community west of the project area. Based upon research on African-American dwellings of this period, it is suggested that evidence of this house would have been ephemeral (briefly occupied, leaving scant remains).

If Mr. Harris' house fronted on North Street, evidence of the house could be discovered if it was not destroyed by the later dwelling at this location. If it was located farther back on the property away from the street, evidence of the house was probably destroyed by the construction and/or demolition of the gas plant. The site would have probably been graded either at the time of construction of the gas plant and/or houses. Since some of the buildings and structures extended below surface in these areas, evidence of his house would have been destroyed. At the time of the demolition of the gas plant, additional grading would have occurred.

B. Prehistoric Period

Using Custer's (1986) model for the distribution of prehistoric sites in Delaware, it was determined that the project area lies in Zone II, which has a Medium/High Significance Probability, Medium Data Quality and a Medium/Low number of known sites (Custer 1986:198). The probability for Woodland Period sites would be higher than for those from Paleo-Indian and Archaic eras. The probability of locating the latter two types of sites, while low, cannot be ruled out entirely. The extent of the impacts to the prehistoric resources by the construction and demolition activities which occurred on the property would have been considerable.

C. Archaeological Field Investigation

The primary purpose of this Phase IA/IIA study was to assess the potential archaeological resources at the site, and to evaluate their potential significance. Extensive historical research has been conducted to accomplish this objective. Historical research cannot, however, absolutely determine the presence or absence of archaeological resources. This would require subsurface investigation. Should the remediation effort require subsurface excavation which would impact potential archaeological resources, archaeological field investigation is recommended. The scope of the archaeological work will be designed so as to best address the research questions while minimizing health and safety risks. The archaeological field investigation will be accomplished in a single episode and will be limited to a period of four weeks, as was agreed to in the September 18, 1992 meeting with EPA, DNREC, and the Delaware SHPO.

Archaeological work would be necessary in those areas disturbed by remedial excavation, to the extent that potentially significant archaeological resources have been predicted in those areas of the site. Should archaeological fieldwork be required, it is recommended that an investigation be conducted (1) to determine the presence or absence of archaeological resources at locations on the site with the highest potential for significant resources to be present; (2) to assess the integrity of any such resources discovered; (3) to evaluate their eligibility for the National Register of Historic Places; and (4) to recover archaeological data related to the historic use of the property., Prior to the initiation of the fieldwork, a detailed Work Plan and a Health and Safety Plan will be developed. Because of the possibility of encountering potentially hazardous materials, appropriate precautions will be employed when conducting subsurface archaeological investigations. Archaeologists working on the site will have completed the appropriate OSHA 40-hour training (29CFR1910.120).

Because of the presence and depth of fill material and the nature of the ground cover in the project area, a backhoe will be employed to remove overburden. Wherever possible, excavation will be completed to avoid exposure to potentially hazardous material. The location of the excavation will be based upon the research questions which were developed as a result of property types anticipated to be present. Property types associated with gas manufacturing fall into two categories: storage and production. Storage facilities include structures to house the fuel necessary for the gasification process, such as coal sheds and oil tanks. Excavation will not occur in these locations as there is little research value. Storage facilities also were used to house the byproducts of the gasification process and include gasholders and tar tanks. Subsurface archaeological investigation is proposed to learn further about gasholders. No archaeological investigation is proposed to examine the tar tanks due to the hazardous nature of the tar.

Gas production will be examined through excavation in the location of the main structure and in the location of the retort building. Archaeological investigation also is proposed at the location of the dwelling (corner of New and North Streets), and at the location of one of the double two-story houses. These resources fit into the historic theme of "settlement patterns and demographic change." Potential archaeological remains include building foundations and/or basements, wells, privies, cisterns and/or trash pits.

To the extent trenching is required for archaeological fieldwork, trenches, their size, and anticipated depth will be indicated in a Detailed Work Plan which will precede remedial activity. The Detailed Work Plan will be developed based upon the scope of remedial activities, the necessary excavation, the potential likelihood for the presence of archaeological resources, and the potential significance of any resources expected. Trenches will be excavated using a 1.5 to 1 slope as per OSHA standards (29CFR1926, Subpart P). An effort will be made to avoid excessive disturbance to potentially hazardous material during investigative activities. Once these materials are encountered, it is recommended that fieldwork cease in that area to avoid exposure. The use of historical photographs and information from the remote sensing and soil borings should allow fairly precise placement of trenches, thus avoiding the need for long exploratory trenches.

After the backhoe removes any modern fill and demolition material overlying intact surfaces or features, hand excavation will be employed. All features will be drawn and photographed. Profile drawings and photographs will be made for all trenches. The location of all trenches and features will be recorded on a site map.

Artifacts will be bagged according to provenience. Bags will be labelled with complete provenience information. Information from each bag will be recorded on a bag inventory sheet. Artifacts will be cleaned and catalogued. Artifact and field data will be analyzed.

A report will be prepared which will describe and analyze the findings of the study. The report will conform with Federal and State guidelines for the preparation of such reports. It will include a description of field methods, site description and analysis, artifact description and analysis, and conclusions. It will contain appropriate plan view and profile drawings and photographs; artifact and feature illustrations; and an artifact inventory.

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APPENDIX A

LIST OF PERSONNEL

Project Manager:	Janice G. Artemel, M.A.
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Industrial Historian:	Frances P. Alexander, M.A.
Architectural Historian:	Christopher C. Martin, M.A.
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Project Archaeologists:	Mark K. H. Walker, M. Phil. John Rutherford, B.A.
Technical Editor	Mary Pickens, B.A.
Graphics:	Allison Coerper, B.A. Sulah Lee, B.A.

APPENDIX B

GEOPHYSICAL SURVEY
DOVER GAS LIGHT SITE
DOVER, DELAWARE

Prepared For:

VERSAR, INC.
Springfield, Virginia

Prepared By:

ENGINEERING-SCIENCE, INC.

Two Flint Hill
10521 Rosehaven Street
Fairfax, Virginia 22030

Project Manager: Janice Artemel

MARCH 1991

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APPENDICES

DOVER GAS LIGHT SITE
GEOPHYSICAL EXPLORATION

1.0 INTRODUCTION

Versar, Inc. has retained Engineering-Science, Inc. (ES) to perform a geophysical survey as it relates to the ongoing archaeological study at the Dover Gas Light Site. ES performed and completed the field work at the site during the week of March 11, 1991. The following report documents the field methods used by ES and presents the results of the geophysical survey at the site.

2.0 PURPOSE

The objective of this geophysical survey was to utilize the data generated during the geophysical survey in conjunction with, and to supplement, data collected during the records search and the archaeological review in order to identify subsurface cultural features.

Electromagnetometry (EM) and Ground Penetrating Radar (GPR) were chosen as the most appropriate geophysical methods to meet the project goals. Prior to initiating the EM or GPR portions of the geophysical survey, ES constructed a grid at the site along a magnetic north-south by east-west orientation while using 30-foot grid node centers. Locations described in this report will be given in reference to the coordinates of this grid. The first coordinate given will be north of south; the second coordinate given will be west of east.

3.0 FIELD METHODS

3.1 EM31 Survey

The EM technique uses an instrument which generates a primary magnetic field. This primary magnetic field induces small currents in the subsurface materials that, in turn, produce a secondary electromagnetic field. The instrument measures the conductivity response within the subsurface materials. The EM unit chosen for this project was the

Geonics EM31. The EM31 operates on a frequency of 9.8 kHz and has a transmitter coil (TX) and receiver coil (RX) that are spaced 3.6 meters apart which are mounted on booms that are attached to a center meter. This allows the EM device to effectively measure ground conductivity in millimhos per meter (mmhos/m) to depths of approximately 15 feet. The reading shown by the central meter is essentially a composite of the subsurface conductivities encountered. The information collected at the Dover Gas Light Site was collected using the EM31 in a vertical dipole arrangement. If the EM device was used in the horizontal dipole arrangement, relative depths to targets could be determined. However, ES also used a GPR unit which supplied the operator with relative depths to targets.

The EM31 was operated while using both the inphase and quadrature phase modes of the instrument. The quadrature phase component of the induced magnetic field is linearly related to the ground conductivity, and hence most readily interpretable in terms of soil and/or geological conditions.

The EM31 was also used to measure the inphase component of the magnetic field. This use of the EM31 is better suited to locating cultural features such as buried metal within the subsurface. Experiments performed by the manufacturer indicate the EM31 will detect a 45-gallon oil drum out to a distance of about 12 feet (Geonics Technical Note TN-11). When interpreting the information collected in the inphase mode, the operator is looking for pulses or a series of pulses in the meter readings which indicate the presence of buried metal or other cultural objects and not necessarily linear subsurface relationships. However, for the purposes of this report, ES presents both the quadrature and inphase measurements recorded in the field as contoured representations of the site.

3.2 Ground Penetrating Radar Survey

GPR is a geophysical method that uses a transmitter/receiver antennae to transmit a high frequency electromagnetic signal into a material; in this case, subsurface materials. The electromagnetic signal is reflected off the interfaces between materials with differing dielectric constants. This reflected signal is then received by the antennae and translated by the profiler into a continuous cross-sectional profile representation of the subsurface materials at the site.

The GPR unit chosen for this project was the Geophysical Survey Systems, Inc. SIR III graphic profiler equipped with a Model 3102 500 Mhz transducer which has a [illegible] nanosecond pulse width. The range setting used at the site was 45 to 50 nanoseconds. The 500 Mhz transducer enabled ES to profile the subsurface materials to depths approaching 15 feet. The 15-foot subsurface depth is based upon a calibration performed on existing subsurface utility lines of a known depth at the site (see Plate #1).

4.0 DATA ANALYSIS

The purpose of this section is not to describe definitively the subsurface features, but rather to provide information from which definitive judgements of conditions occurring in the subsurface may be made.

EM was used to locate anomalous areas in the subsurface materials at the site. These anomalous areas were located by collecting quadrature phase and inphase magnetic field measurements at the grid nodes along the survey traverses. These same traverses were also crossed with the GPR. This gave ES cross-sectionional and plan-view representations of the subsurface. The cross sections were used to develop a plan view drawings showing subsurface electromagnetic anomalies at the site. Information generated during the EM and GPR surveys has been integrated to give a representative interpretation of the subsurface. Originally, ES intended to present Versar with one plan view drawing. However, the anomalous conditions observed in the subsurface are better illustrated by three separate map view drawings showing the EM-Inphase Data (Figure 1), the EM-Quadrature Phase Data (Figure 2), and the Ground Penetrating Radar Data (Figure 3).

The inphase component of the magnetic field was the first subsurface geophysical parameter measured at the Dover Gas Light Site. Strong anomalous areas were observed at the site. The majority of these anomalies centered at depths of 5 feet to 10 feet below the ground surface at areas A through G (A at 30-0, B at 60-30, C at 60-115, D at 180-30, E at 240-105, F at 360-0 and G at 360-115). Several of these anomalies could be explained by cultural features observed at the surface. Those that could be explained included those found at B, where an iron railing was adjacent to the measurement point, and C, which was over located above the water lines leading into the museum building. It should also be noted that the inphase measurements were more affected by the museum building than the

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quadrature phase measurements. The anomalies occurring at F and G appear to have been caused by aboveground utilities occurring at the site. The remaining anomalies at A, D, and the anomalous area centered around E do not appear to have aboveground explanations. Lettered anomalies are repeated on more than one drawing where anomalous areas coincide with measurements taken using different techniques or instruments.

Negative deflections were observed while taking inphase measurements at data collection points occurring near the center of the site. Negative deflections may indicate heterogeneity in the subsurface materials. The presence of non-polar fluids may be a possible explanation but not necessarily the only explanation for the negative deflections. Roughly, this negative deflection area was bound to the north by the 270 east-west line where it turned southwest to 210-90, headed due south to 120-90, headed due east to 90-0, where the negative deflections were then observed to follow the 0 north-south and 0 east-west lines. A general statement may be made concerning the EM inphase magnetic field observations at the site. Conductivities are higher in the northern one-third and western one-fifth of the site. The higher readings in the western one-fifth of the site may be explained by the presence of overhead utility lines and the presence of parked automobiles along South Street.

The quadrature phase measurements made of the subsurface with the EM31 were linear indicators of composite subsurface conductivities. The EM31 measured two quadrature phase negative meter readings indicating heterogeneity in the subsurface. These occurred at anomalous areas H and I (H at 0-0 and I at 150-60). Relatively high conductivity observations (those readings above 200 mmhos/m) were observed near the iron railing at the rear of the museum (B), where the leveled brick building was located (J), and at F and E where high EM measurements were observed in both the quadrature and inphase components of the magnetic fields (F at 330 to 360-60 and E at 240-90).

The GPR was not affected by the cultural features found on or above the ground surface at the site. The information collected during the GPR survey showed the subsurface to be a complex combination of natural and culturally-placed fill. The majority of the fill areas ranged in depth from 5 to 10 feet, but more shallow and deeper fill areas were also encountered. The fill areas appear to lie along both the eastern and western perimeters of the site. The northwest quadrant of the site north of the 315 grid line appears to be fill. Cultural features that were observed include two areas which could be interpreted as building pads: the northern most anomaly (K) is located between the 305 to 360 north-south lines and the 85 to 105 east-west lines; the southern most anomaly (L) occurs between the 210 and 160 north-south grid lines and the 70 and 100 east-west grid lines. Linear anomalies occur in the area from 0 to 60 (A) along the north-south line and 0-30 along the east-west line. These anomalies resemble potential piping. Other more irregular anomalies occurred centering on the following coordinates: 240-90 (I), 260-60 (J), 225-30 (M) and 150-50 (N). Features relating to the utilities at the edge of the property and relating to the museum building were also observed.

Areas where the GPR image produced by the profiler was degraded and the reflected signal was diminished were also encountered. The degradation of the GPR reflected signal is encountered where the material being scanned is not penetrated by the electromagnetic signal. These areas were apparent north of the 100 east-west line to the 195 east-west line between the 100 and 80 north-south lines and extending over the site westward to the 115 north-south line from the 0 north-south line. The degraded signal continued along an axis which ran through the center of the site and thinned as it continued north before ending at the 300 east-west line. The degraded GPR image may also be indicative of changed conditions in the subsurface materials.

5.0 CONCLUSION

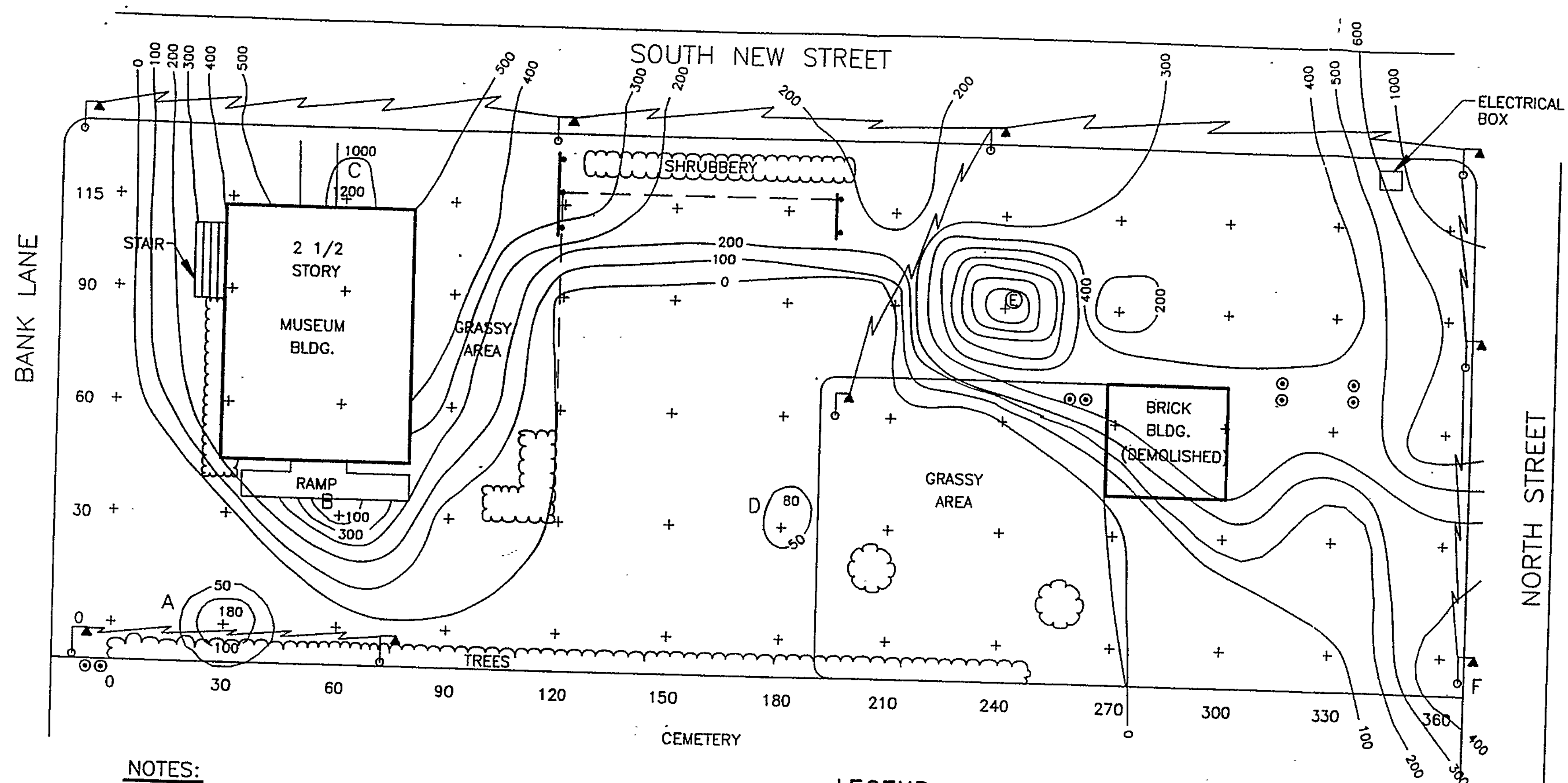
The subsurface anomalies encountered at the Dover Gas Light Site during the EM and GPR surveys have been plotted on three figures. Several of these anomalies were apparent when measured by more than one geophysical technique. After reviewing measurements observed in the field, the datum collected appears to have generated reasonably clear results. The anomalies located during this project must be viewed in a site specific context before a definitive identification of their nature is apparent.

6.0 QUALIFICATIONS

The information presented in this report is based upon interpretation and is dependent upon conditions encountered in the field and operator experience. Conditions in the subsurface at the Dover Gas Light Site are complex. Although GPR and EM can be used to locate subsurface features, variations in the subsurface materials can affect interpretations and obscure potential features of interest. If questions or uncertainties exist concerning anomaly identification, actual subsurface conditions should be documented by boring, trenching or excavation.

APPENDIX A

FIGURES



NOTES:

1. CONTOUR SHOWN ARE MMHOS/M.
2. SURVEY PERFORMED USING VERTICAL DIPOLE CONFIGURATION.

LEGEND

- UTILITY POLE
- OVERHEAD LINE
- TREE OR BUSH
- WOODEN GUARD RAIL
- STEEL POLES

0 30 60

.1' = 30'

PROJECT NUMBER		DATE
DESIGNED BY	J.R. J. BOWERS	5/29/9
DRAWN BY	S.P.FENNER	5/29/9
CHECKED BY		
ENGINEER		

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DOVER GAS LIGHT SITE

CONTOUR DIAGRAM SHOWING INPHASE MEASUREMENTS PERFORMED WITH EM–31

AS SHOWN

FIGURE–1

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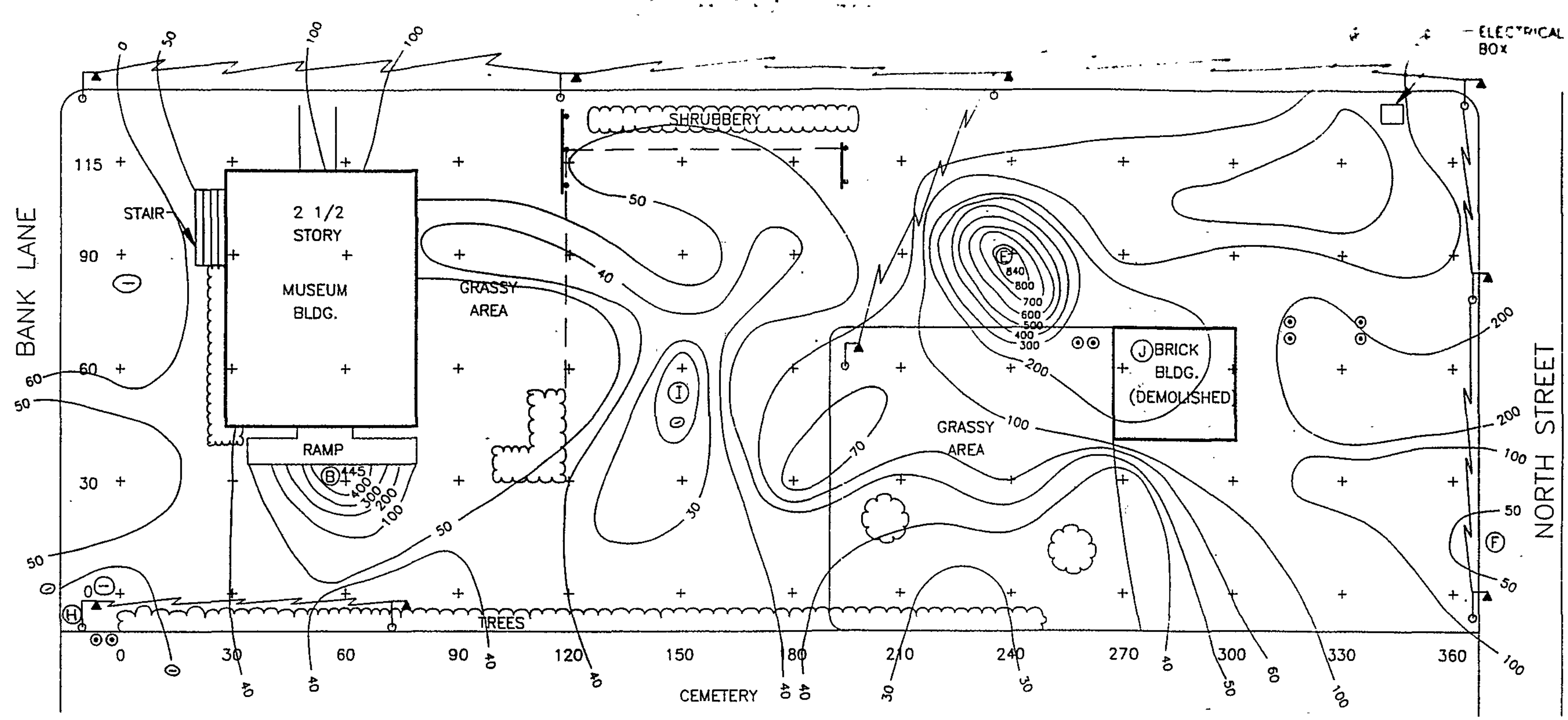

NOTES:

1. CONTOUR SHOWN ARE MMHOS/M.
2. SURVEY PERFORMED USING VERTICAL DIPOLE CONFIGURATION.

LEGEND

- UTILITY POLE
- OVERHEAD LINE
- TREE OR BUSH
- WOODEN GUARD RAIL
- STEEL POLES

0 30 60
1' = 30"

PROJECT NUMBER		DATE	
DESIGNED BY	J.R. J. BOWERS	5/29/91	
DRAWN BY	S.P.FERRER	5/29/91	
CHECKED BY			
ENGINEER			
REGISTRATION NUMBER		DATE	

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DOVER GAS LIGHT SITE

CONTOUR DIAGRAM SHOWING QUADRATURE PHASE-MEASUREMENTS PERFORMED WITH EM-31

AS SHOWN

FIGURE-

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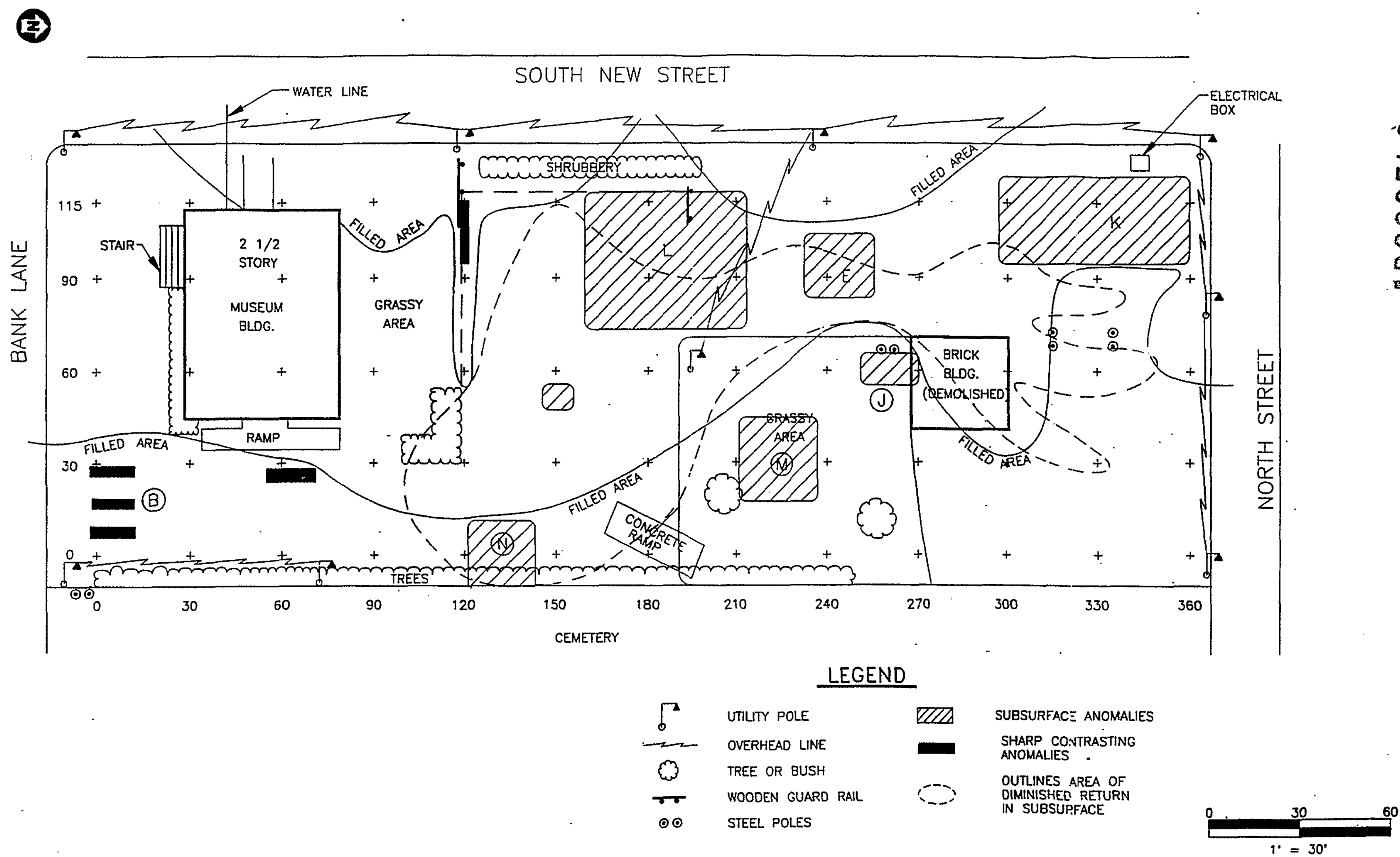

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				DRAWN BY	S.P.FERNER	3/29/9
				CHECKED BY		
				ENGINEER REGISTRATION NUMBER		DATE

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DOVER GAS LIGHT SITE

GROUND PENETRATING RADAR SURVEY DIAGRAM

AS SHOWN

FIGURE–

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APPENDIX B

TABLES

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TABLE 1

EM INPHASE DATA
IN MMHOS/M

South-to-North Grid Line Coordinates (Distances in Feet)	East-to-West Grid Line Coordinate (Distances in Feet): 0	30	60	90	115
0	Neg	Neg	Neg	Neg	Neg
30	180	<1	-	-	800
60	Neg	420	-	-	1,200
90	Neg	30	180	420	420
120	Neg	Neg	Neg	Neg	390
150	Neg	Neg	Neg	Neg	120
180	Neg	80	Neg	Neg	211
210	Neg	Neg	Neg	Neg	180
240	Neg	Neg	Neg	4,500	240
270	Neg	Neg	630	150	330
300	20	240	420	300	390
330	70	120	420	330	390
360	420	390	660	510	1,000

HW/FW018/FJB0874H.TBL

TABLE 2

EM QUADRATURE PHASE DATA
IN MMHOS/M

North-to-South Grid Line (Distances in Feet)	East-to-West Grid Line (Distances in Feet) 0	30	60	90	115
0	Neg	80	Neg	Neg	Neg
30	40	40	-	-	85
60	35	445	-	-	115
90	35	65	70	45	60
120	40	40	80	40	50
150	33	26	Neg	56	45
180	41	48	60	39	50
210	33	18	69	54	55
240	30	60	180	840	65
270	250	60	285	80	65
300	60	125	185	120	75
330	130	70	240	100	70
360	80	80	220	100	120

APPENDIX C

RESEARCH QUESTIONS FOR THE ARCHAEOLOGICAL INVESTIGATION OF THE DOVER GAS LIGHT SITE

A Phase IA/IIA Study of the Dover Gas Light Superfund Site ("the site") in Dover, Delaware was conducted by Engineering-Science, under contract to Versar, Inc of Springfield, Virginia and Consoer, Townsend & Associates of Fairfax, Virginia for Chesapeake Utilities Corporation of Dover, Delaware. Chesapeake Utilities Corporation agreed to conduct a Remedial Investigation/Feasibility Study (RI/FS) in accordance with the Administrative Order By Consent executed among the Delaware Department of Natural Resources and Environmental Control (DNREC), United States Environmental Protection Agency (EPA) Region III, and Chesapeake Utilities.

The investigation was performed as part of the RI/FS for the site in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended. Section 106 requires that:

> The head of any Federal agency having direct or indirect jurisdiction over a proposed Federal or federally assisted undertaking in any State and the head of any Federal department or independent agency having authority to license any undertaking shall, prior to the approval of the expenditure of any Federal funds on the undertaking or prior to the issuance of any license, as the case may be, take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register (16 U.S.C. 470f).

The site is included on the National Register of Historic Places as part of the Delaware State Museum site, also known by the historic name, *Old Presbyterian Church* complex. The National Register nomination did not include consideration of archaeological resources on the property, and thus the Phase IA/IIA study was conducted to identify such resources on the site, and to evaluate whether they might be eligible for inclusion in the National Register. It was necessary that activity be conducted prior to implementation of remediation action on the site.

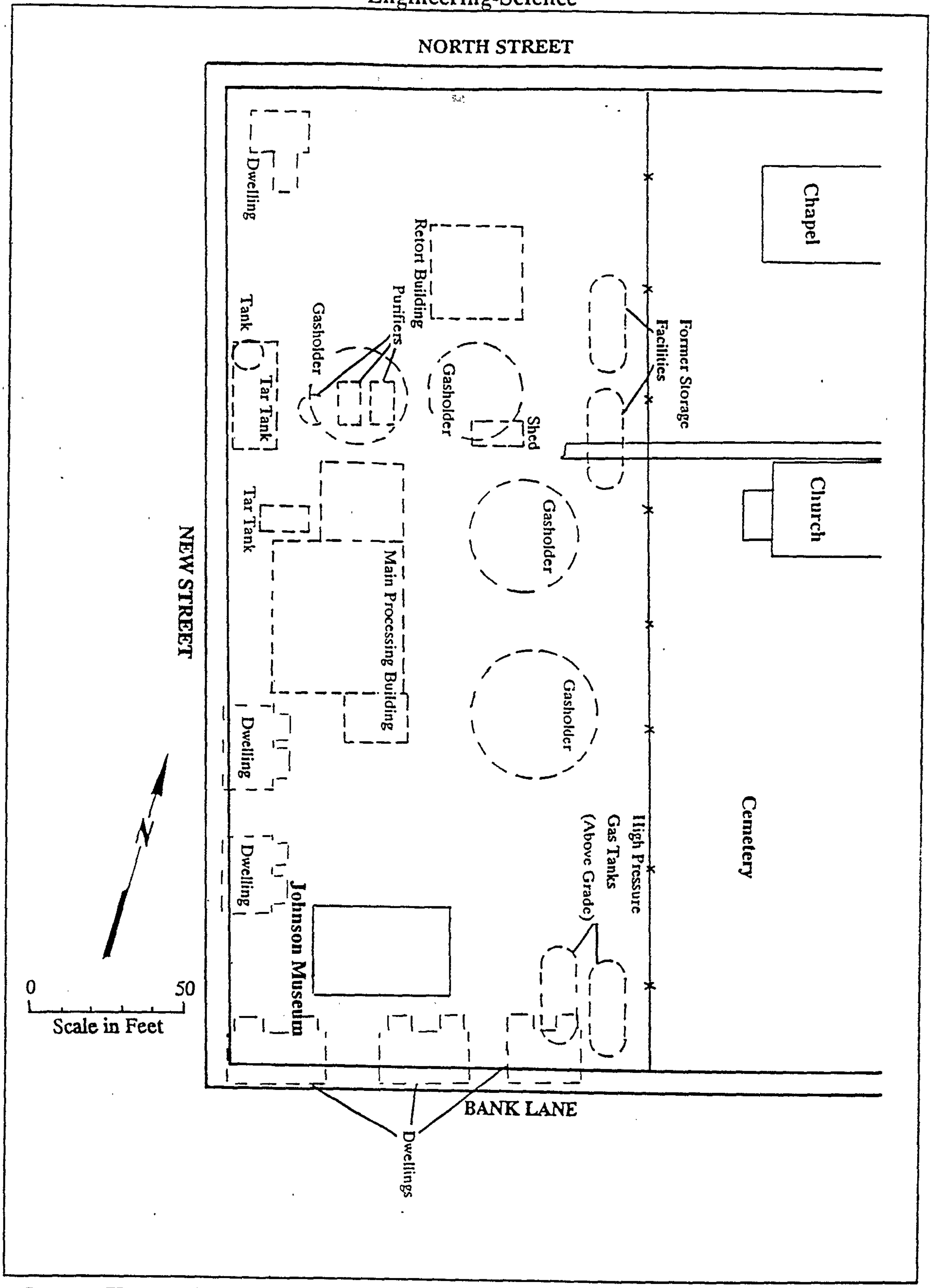
Archaeological work was carried out in accordance with the standards of the Advisory Council on Historic Preservation and the National Park Service (36CFR800; 36CFR66), and the "Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation" (48 FR 44716-44742).

The former manufactured gas plant produced gas for industrial, commercial, and residential use, as well as street lighting. The plant, which operated from 1859 until 1948 when operations ceased, was dismantled between 1948 and 1949. At the completion of demolition activities, one building was left standing; other structures were removed for off-site disposal; and some debris was reportedly buried on-site.

The Phase IA/IIA study presented the history of land use at the Dover Gas Light site; a summary of information regarding the plant's management, operation and closure; and a history of the gas manufacturing industry, technology and processes. This study also included an analysis of the results of a geophysical study and soil borings on-site. The intent of these studies was to determine the potential significance of any archaeological resources at the site; to evaluate the need for subsurface archaeological testing to locate and identify archaeological deposits associated with historical activities on the site; and, if appropriate, to recommend testing locations that would locate and identify such resources, if present, in a manner that would permit evaluation of their eligibility for the National Register of Historic Places. Since there may be hazardous or toxic materials on the site, recommendations for subsurface archaeological excavation would be designed to meet the goals of the National Register evaluation, while minimizing exposure to potentially hazardous materials. During the September 18, 1992 meeting on archaeological field work, it was agreed that "the field investigation could be achieved with a single opening of the site subsequent to the Record of Decision. If the selected remedy for the site includes excavation, then the Phase I/II/III field investigation will occur as the first stage of remedial action." It was further agreed, "that the estimated time for completion of the archaeological investigation would be four (4) weeks" (Letter to Jack Reinhard from Stephen Johnson, September 30, 1992; hereinafter referred to as Johnson 1992).

The potential resources on the site were evaluated in reference to Delaware's State Preservation Plan. These resources may include structural and material remains associated with the former manufactured gas plant, as well as with several domestic structures which stood on the site at one time *(Figure 1)*. The two historical periods which are most relevant to the Dover Gas Light Site are *Industrialization and Early Urbanization* (1830-1880+/-) and *Urbanization and Early Suburbanization* (1880-1940+/-). The former manufactured plant most closely corresponds to the historic theme, "manufacturing" and the subtheme, "chemical production and processing." Although the Dover Gas Plant eventually came under public regulation, its period of greatest importance occurred under private ownership, and its importance relates to its role in technological and urban development rather than as a governmental service. The domestic structures fit into the historic theme of "settlement patterns and demographic change."

The questions regarding the Dover Gas Light Site have been formulated using the four research domains presented in the Delaware Management Plan: (1) Domestic Economy, (2) Manufacturing and Trade, (3) Landscape, and (4) Social Group Identity, Behavior and Interaction (DeCunzo and Catts 1990). The purpose of using these domains is to "insure the asking of comparable research questions and the collection of comparable data across comparable themes." These domains have been correlated with the state's historic context framework in order to integrate research from all the state's historic period cultural resources. Specific issues for research have been developed which are relevant to historical periods, historical themes and geographic regions (DeCunzo and Catts 1990:16). The questions and issues within each research domain for the two relevant historical periods, *Industrialization and Early Urbanization* (1830-1880+/-) and *Urbanization and Early Suburbanization* (1880-1940+/-), are very similar.



Source: Versar, Inc.

Dover Gas Light

Figure 1
Former Structures at the Dover Gas Light Site

I. FORMER DOVER GAS LIGHT MANUFACTURED GAS PLANT (1859-1950)

-- identification of the property, or portions of the properties where data recovery is to be carried out.

The site is bounded by North Street on the north; the Presbyterian Church and Cemetery on the east; Bank Lane on the south and New Street on the west.

-- identification of any property, or portions of the properties that will be destroyed or not mitigated.

If the selected remediation does not involve subsurface disturbance, then no field investigation will be required as part of the Section 106 process. If the selected remediation for the site includes excavation, then the Phase I/II/III field investigation will occur as the first stage of remedial action (Johnson 1992). In this respect, our approach is similar to that taken by the Department of Transportation and other federal agencies. Archaeological investigations typically only occur in the property roadway or right-of-way where archaeological resources may be impacted by the construction project.

-- the research questions to be addressed through the data recovery, with an explanation of their relevance and importance.

The former Dover Gas Light Manufactured Gas Plant may provide the opportunity to address some important research questions in historical and industrial archaeology, in general, and about the evolution of the gas manufacturing technology, in particular. Questions regarding the gas plant are formulated using three of the four research domains presented in the Delaware Management Plan: (1) Manufacturing and Trade, (2) Landscape, and (3) Social Group Identity, Behavior and Interaction (DeCunzo and Catts 1990).

The growth and evolution of the former manufactured gas plant corresponds to two historic periods: *Industrialization and Early Urbanization* (1830-1880+/-) and *Urbanization and Early Suburbanization* (1880-1940+/-). The plant most closely corresponds to the historic theme, "manufacturing" and the subtheme, "chemical production and processing." Although the Dover Gas Plant eventually came under public regulation, its period of greatest importance occurred under private ownership, and its importance relates to its role in technological and urban development rather than as a governmental service.

The model presented in the Delaware Plan proposes that the questions guiding industrial archaeology consider "the worker and the social and economic context of the industrial revolution as well as the processes of production and the evolution of technology" (DeCunzo and Catts 1990:145). The Dover Gas Light Plant may provide the opportunity for such a study.

Depositions indicate that salvageable equipment was taken off-site prior to demolition. Geophysical surveys revealed subsurface anomalies in limited areas that may represent remnant structures or features. Nevertheless, any extant subsurface structural features from the property types of storage and production, as well as gas piping and fittings will provide information on the manufacturing process and the physical and cultural landscape of the plant. Such information will contribute data on construction design, spatial relations between and within structures, and the placement of equipment. The materials from which the archaeological resources are made may provide information on the trade networks of the gas light industry and indicate the adoption of technological improvements.

Historical research has provided information on marketing and the distribution of the product and the effect of gas lighting on the city of Dover and Delaware in general. Research and oral history interviews have provided information on the workforce stratification, responsibilities, work conditions, and ethnicity. Although unlikely, data may remain on the site which would indicate group behavior and where interactions took place.

Specific research questions are:

1. QUESTIONS ADDRESSING THE MANUFACTURING AND TRADE DOMAIN

Is evidence of changing technology observable in the archaeological record (subsurface archaeological features and associated artifacts on the site)?

Both coal carbonization and carbureted water gas making processes are known to have occurred at the former Dover Gas Light Manufactured Gas Plant. Technological innovations associated with the adoption of a new gas making process would have caused modifications to the facility which may be observable in the archaeological record. These modifications could include different types of gas holders, retort ovens, piping, etc., evidence for which may be present on the site. This site may provide the opportunity to study the evolution of technology and the processes of production.

Extant subsurface structural features from the property types of gas storage and production, as well as, gas piping and fittings, if present, would provide information on the gas manufacturing process. Such information will contribute data on construction design, spatial relations between and within structures, the placement of equipment, and the types of material used. An analysis of this data will in turn supply information on technological change in design and process, and a means of assessing the speed in which technological improvements were adopted.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

Did the Dover Gas Plant strictly utilize the gas making processes and materials described in the archival record?

The gas making processes, and the materials and equipment which are described as being needed to carry out such processes as is evidenced in the archival record presents the ideal or model. In each town, including Dover, the gas plant was designed to fulfill local needs and expectations. Did they *"make do"* with materials or equipment which might have been somewhat less than the *ideal* equipment described in the archival record? Conversely, did they use the state-of-the-art technology to further the other economic enterprises of the owners (ie. the canning industry).

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

Is any evidence available in the archaeological record which indicates where and when the materials used in the gas making process were manufactured?

This information would allow us to reconstruct the patterns of trade in the gas light industry. It would allow us to examine the impact of the railroad on the industry and would allow us to know more about commercial manufacturing patterns.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. If artifacts and objects recovered on the site include maker's marks, patent labels, dates and/or places of origin, this would allow us to answer this question. Additional archival research will be conducted if warranted by material remains recovered.

2. QUESTIONS ADDRESSING THE LANDSCAPE DOMAIN

Does the physical layout of the gas plant and changes in the physical layout relate only to functionality [ie. technology] or does it relate to other factors, such as constraints of the property or social, economic or cultural considerations? Are temporal changes observable?

> *...the cultural landscape of a production site results from the interaction of a complex network of factors. Technology, the manufacturer's cultural/ethnic background and traditional knowledge, economic means, and social status and aspirations are all played out in the physical site (DeCunzo and Catts 1990:21).*

Extant subsurface structural features from the property types of storage and production, as well as, gas piping and fittings will provide information on the physical and cultural landscape of the plant. Additional archival research and oral history interviews will be conducted, if warranted, after archaeological excavation to clarify and explain the subsurface findings.

Was the "physical presence" or the exterior of the plant designed to reflect the company's importance?

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

Is there evidence in the archaeological record that contradicts what appears on historical maps?

Sometimes archaeological evidence provides information which disproves what is presented in the historical record. Architectural plans for this plant have not been located and current knowledge of the facility comes from nineteenth-century generic plans, a few photographs and maps. Diagnostic materials specific of varying manufacturing processes may remain on site that would answer this question.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

3. QUESTIONS ADDRESSING THE SOCIAL GROUP IDENTITY, BEHAVIOR AND INTERACTION DOMAIN

Is there artifactual material remaining on the gas plant site which can be associated with the gas plant workers rather than the gas making process?

Although it is likely that much of the sheet refuse associated with the gas plant was graded away when the gas plant was demolished, subsurface materials may exist which contain artifacts relating to the gas workers. If present, these materials could provide information regarding the social interaction of gas plant workers.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

II. DWELLING AT THE CORNER OF NORTH AND NEW STREETS (1875 - c. 1919)

-- **identification of the property, or portions of the properties where data recovery is to be carried out.**

The dwelling and any associated outbuildings were located at the corner of North and New Streets.

-- **identification of any property, or portions of the properties that will be destroyed or not mitigated.**

If the selected remediation does not involve subsurface disturbance, then no field investigation will be required as part of the Section 106 process. If the selected remediation for the site includes excavation, then the Phase I/II/III field investigation will occur as the first stage of remedial action (Johnson 1992). In this respect, our approach is similar to that taken by the Department of Transportation and other federal agencies. Archaeological investigations typically only occur in the property roadway or right-of-way where archaeological resources may be impacted by the construction project.

-- **the research questions to be addressed through the data recovery, with an explanation of their relevance and importance.**

This dwelling may provide the opportunity to address some important research questions regarding an urban/industrial domestic site in Dover and will also more generally increase existing research about Delaware's history and historical archaeology. Questions regarding this domestic site are formulated using the four research domains discussed in the Delaware State Plan; (1) Domestic Economy, (2) Manufacturing and Trade, (3) Landscape, and (4) Social Group Identity, Behavior and Interaction (DeCunzo and Catts 1990).

The dwelling corresponds to two historic periods: *Industrialization and Early Urbanization* (1830-1880+/-) and *Urbanization and Early Suburbanization* (1880-1940+/-). It further fits into the historic theme of "settlement patterns and demographic change."

Existing subsurface architectural features from the dwelling and associated outbuildings may provide information about the placement and components of an urban house site, evolution of land use, and alteration and meaning of the landscape.

Artifacts from wells and/or privies, if present, including ceramics, bottle glass, faunal remains, such as bones and shells, and other artifacts will provide detail on an array of subjects. One important development during the late nineteenth and early twentieth century was the increasing consumer rather than producer orientation of individual household economies. Material remains may indicate this transition and provide an opportunity to examine local and regional trade networks and the operation of the nineteenth- and twentieth-century economy. In addition, the material remains will provide information on social and economic status and subsistence patterns. Finally, material remains may define how this structure was used by gas plant employees.

Specific research questions are:

1. QUESTIONS ADDRESSING THE DOMESTIC ECONOMY DOMAIN

Does the archaeological record from this site indicate that the occupants of this dwelling were producing any goods for their own consumption or were they merely consumers?

During the colonial period and into the nineteenth century, it was common for people to produce goods for their own consumption in their own home. This could range from food preparation such as home canning and churning butter to tool making. Archaeological evidence which indicates goods produced at home and/or purchased goods may be present in the archaeological record.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

2. QUESTIONS ADDRESSING THE MANUFACTURING AND TRADE DOMAIN

Do the archaeological remains associated with this dwelling have any association with the gas plant?

This dwelling was constructed by Richardson and Robbins, the owners of the gas light plant, and was occupied by one the Company's employees, Peter Moore in 1875. It is likely that this structure continued to be associated with the gas plant, but its actual use has not been determined.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

What information on local and regional trade networks do the ceramic wares present in the assemblage provide [ie. are the occupants buying local or imported ceramics?].

If ceramics are present in the trenches excavated, they will be examined for makers marks. Where available, the information on the origins of ceramics will be studied in an attempt to determine trade networks. Additional archival research will be conducted if warranted by the ceramics recovered.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. If present, any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

Are the occupants utilizing locally produced products? This information would be available through an examination of bottle glass and/or tin cans (if they were preserved). Are the contents being produced in local companies.

If such artifactual materials are present in the assemblage, they will be examined to determine where they were produced. This data will provide data on local trade networks and preference for certain products.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

3. QUESTIONS ADDRESSING THE LANDSCAPE DOMAIN

Does the spatial arrangement of this property conform to similar urban domestic sites in Delaware?
Existing subsurface architectural features may provide information about the placement and components of an urban house site, evolution of land use, and alteration and meaning of the landscape.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

4. QUESTIONS ADDRESSING THE SOCIAL GROUP IDENTITY, BEHAVIOR AND INTERACTION DOMAIN

Does data derived from the application of Miller's Economic Scaling (1980; 1991) of ceramics correspond with what is known about the economic status of the occupants based upon the archival record?

This question assumes that the house was occupied by individuals who worked at the Dover Gas Light Plant. Wages of plant workers are known. This can be used to test the validity of Miller's economic scaling. If a statistically valid sample of ceramics is found, in the trenches excavated, which is appropriate for Miller's economic scaling, such a study will be conducted for these ceramics.

What information is available through an examination of floral and faunal materials to determine subsistence? What types of meats are being utilized? Are the meats strictly from domesticated animals or is there evidence of wild game? If there is wild game in the assemblage, can this be related to the ethnicity and/or socio-economic status of the household? What do the faunal remains [ie. cuts of meat] say about the economic status and/or ethnicity of the occupants?

Floral materials, such as seeds and plant remains, and faunal materials such as bones and shells, if present in the excavated trenches, will be studied to determine species and information on the cuts of meat being used, butchery practices, and dietary preferences. The findings will then be compared to the findings on other similar sites and analyzed to provide information on subsistence, socio-economic status and ethnicity.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

If there are discrete occupation levels which can definitely be associated with certain ethnic or social groups, can a difference be seen in the artifact assemblage?

This archaeologically derived data may show preferences of certain vessel types, meat cuts or products in general among different ethnic groups. Findings from this site will then be compared with other sites in Delaware and the region.

III. HOUSES ON BANK LANE (c. 1885 - c. 1915)

The houses on Bank Lane were constructed and demolished prior to the availability of water and sewer hook-ups. These services were probably available by the mid-to-late 1930s (Nichols 1993; personal communication). Therefore, it is likely that wells and privies were being used.

In 1948 and 1949, two 4 inch bare steel gas mains were installed north of the north curb of Bank Lane. These mains terminated at a pressure reducing pit which has since been removed. The installation of these mains, and the removal of the pressure reducing pit would have caused localized disturbance to archaeological resources near the front of the lots.

Archaeological resources also would have been affected during the construction of the Johnson Building. Grading of the property would have affected surface deposits. However, deep subsurface features could remain, if they were not destroyed during the construction or demolition of structures associated with the former Dover Gas Light Manufactured Gas Plant.

-- **identification of the property, or portions of the properties where data recovery is to be carried out.**

The five double two-story houses were located along Bank Lane and New Street.

-- **identification of any property, or portions of the properties that will be destroyed or not mitigated.**

Remediation of the Dover Gas Light Site will not affect the Johnson Building. Only those areas outside of the Johnson Building which will be subject to subsurface disturbance during remediation will require archaeological investigation. In this respect, our approach is similar to that taken by the Department of Transportation and other federal agencies. Archaeological investigations typically only occur in the property roadway or right-of-way where archaeological resources may be impacted by the construction project.

-- **the research questions to be addressed through the data recovery, with an explanation of their relevance and importance.**

These houses may provide the opportunity to address some important research questions regarding urban domestic sites in Dover and will also more generally increase existing research about Delaware's history and historical archaeology. Questions regarding these dwellings have been formulated using the four research domains discussed in the Delaware State Plan; Domestic Economy, Manufacturing and Trade, Landscape, and Social Group Identity, Behavior and Interaction (DeCunzo and Catts 1990).

These dwellings corresponds to the historic period of *Urbanization and Early Suburbanization* (1880-1940+/-) and the historic theme of "settlement patterns and demographic change."

These five dwellings were constructed by Jacob G. Lewis sometime between 1886 to 1897, and were rented out to tenants. In 1900, the dwellings along Bank Lane were occupied by white working class families. Research to date has not revealed any association between these homes and the adjoining gas plant. The property they were located on was purchased by the Dover Gas Light Company in 1910 and the houses were demolished between 1911 and 1919.

Existing subsurface architectural features from the dwellings and their associated outbuildings, if present, will provide information about the placement and components of an urban house site and late nineteenth century urban settlement patterns.

Artifacts from wells and/or privies, if present, including ceramics, bottle glass, faunal remains, such as bones and shells, and other artifacts will provide detail on an array of subjects. One important development during the late nineteenth and early twentieth century, particularly in urban areas, was the increasing consumer rather than producer orientation of individual household economies. Material remains may indicate this transition and provide an opportunity to examine local and regional trade networks and the operation of the nineteenth- and twentieth-century economy. In addition, the material remains will provide information on social and economic status, and subsistence patterns.

Specific research questions are:

1. Questions Addressing the Domestic Economy Domain

Does the archaeological record from this location indicate that the occupants of these dwellings were producing any goods for their own consumption or were they merely consumers?

During the colonial period and into the nineteenth century, it was common for people to produce goods for their own consumption in their own home. This could range from food preparation such as home canning and churning butter to tool making. Archaeological evidence which indicates goods produced at home and/or purchased goods may be present in the archaeological record.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

2. Questions addressing the Manufacturing and Trade Domain

What information on local and regional trade networks do the ceramic wares present in the assemblage provide [ie. are the occupants buying local or imported ceramics?].

If ceramics are present in the trenches excavated, they will be examined for makers marks. Where available, the information on the origins of ceramics will be studied in an attempt to determine trade networks. Additional archival research will be conducted if warranted by the ceramics recovered.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

Are the occupants utilizing locally produced products? This information would be available through an examination of bottle glass and/or tin cans (if they were preserved). Are the contents being produced in local companies?

If such artifactual materials are present in the assemblage, they will be examined to determine where they were produced. This data will provide data on local trade networks and preference for certain products.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

3. Questions addressing the Landscape Domain

Does the spatial arrangement of this property conform with similar urban domestic sites found elsewhere in Delaware?

Existing subsurface architectural features may provide information about the placement and components of an urban house site, evolution of land use, and alteration and meaning of the landscape.

This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

4. QUESTIONS ADDRESSING THE SOCIAL GROUP IDENTITY, BEHAVIOR AND INTERACTION DOMAIN

Can the economic status of the occupants of these houses be discerned through the application of Miller's Economic Scaling (1980; 1991) of ceramics?

If a statistically valid sample of ceramics, can be recovered from the trenches excavated, and is appropriate for Miller's Economic Scaling, such a study will be conducted for these ceramics and the results will be compared with the findings from the house at the corner of North and New Streets.

What information is available through an examination of floral and faunal materials to determine subsistence? What types of meats are being utilized? Are the meats strictly from domesticated animals or is there evidence of wild game? If there is wild game in the assemblage, can this be related to the ethnicity and/or socio-economic status of the household? What do the faunal remains [ie. cuts of meat] say about the economic status and/or ethnicity of the occupants?

Floral materials, such as seeds and plant remains, and faunal materials, such as bones and shells, if present in the excavated trenches, will be studied to determine species and information on the cuts of meat being used, butchery practices, and dietary preferences. The findings will then be compared to the findings on other similar sites and analyzed to provide information on subsistence, socio-economic status and ethnicity.

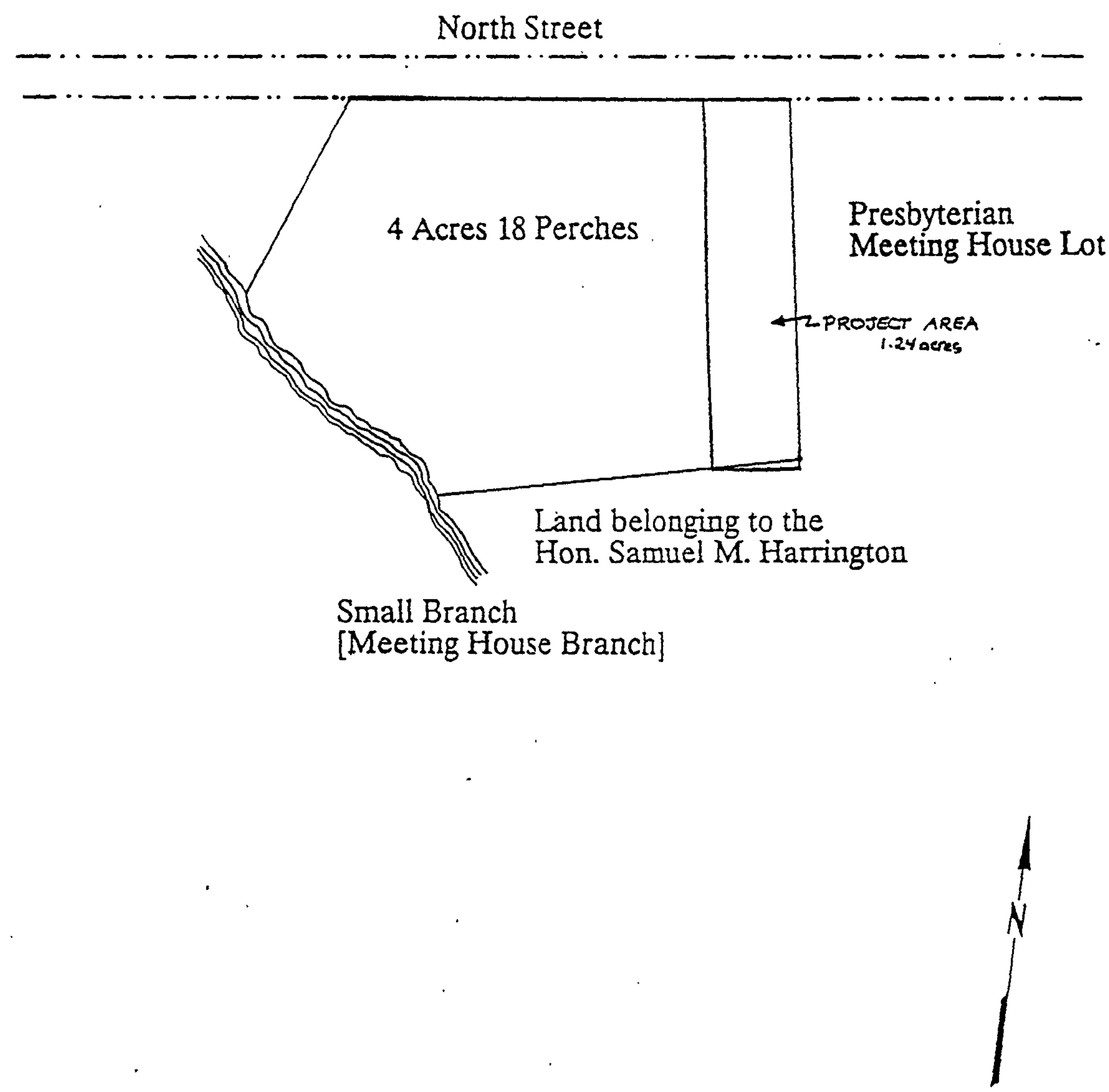
This question will be addressed through the excavation of trenches, if any remediation requires disturbance of the subsurface. Any material remains uncovered in these trenches will be analyzed. Additional archival research will be conducted if warranted by material remains recovered.

IV. JOHN HARRIS HOUSE

There is a low probability that Mr. Harris' house was located within the project area. The project area is 1.24 acres of the 4 acres 18 perches upon which the Harris house was located (*Figure* 2). In addition, it is likely that his house would have been located closer to the African-American community west of the project area. Based upon research on African-American dwellings of this period, it is suggested that evidence of this house would have been ephemeral (briefly occupied, leaving scant remains).

Can evidence of John Harris' house be expected to be present?

If Mr. Harris' house fronted on North Street, evidence of the house could be discovered, if it was not destroyed by the later dwelling at this location. If it was located farther back on the property away from the street, evidence of the house was probably destroyed by the construction and/or demolition of the gas plant. The site would have probably been



Source: Kent County Orphans Court N:72

Figure 2
Property Sold to
Van Burkelow in 1834

graded either at the time of construction of the gas plant and/or houses. Since some of the buildings and structures extended below surface in these areas, evidence of his house would have been destroyed. At the time of the demolition of the gas plant, additional grading would have occurred. If evidence of his house is identified during excavation of trenches in the established locations, the materials recovered will be analyzed.

V. PREHISTORIC

Using Custer's (1986) model for the distribution of prehistoric sites in Delaware, it was determined that the project area lies in Zone II, which has a Medium/High Significance Probability, Medium Data Quality and a Medium/Low number of known sites (Custer 1986:198). The probability for Woodland Period sites would be higher than for those from Paleo-Indian and Archaic eras. The probability of locating the latter two types of sites, while low, cannot be ruled out entirely.

Do prehistoric archaeological remains exist in the project area?

The extent of the impacts to any prehistoric resources present by the construction and demolition activities which occurred on the property would have been considerable. Prehistoric remains which may have been present were probably destroyed; however, there is some potential for localized intact prehistoric materials to be present. If prehistoric artifacts are identified during excavation of trenches in the established locations, they will be analyzed.

APPENDIX D

APPENDIX D
DOVER GAS LIGHT SITE, DOVER, DELAWARE
PHASE IB/PHASE IIB/PHASE III ARCHAEOLOGICAL INVESTIGATION
ARCHAEOLOGICAL CONCEPTUAL WORK PLAN

OBJECTIVE

This project is to conduct Phase IB/Phase IIB/Phase III archaeological subsurface investigation to be conducted at the Dover Gas Light Site in Dover, Delaware. The purpose of the Phase IB/Phase IIB/Phase III archaeological subsurface investigation is to determine the presence or absence of archaeological resources predicted to be present in specific subsurface areas to be disturbed by remedial excavation. If such resources are present the project goal is to determine the integrity, boundaries, and cultural affiliation of the resources and to evaluate their eligibility for the National Register of Historic Places. Potentially hazardous materials are anticipated to be present on the site. Occupational Safety and Health Administration (OSHA) guidelines will be followed while excavating on this site (29 CFR Part 1910).

The archaeological investigation will be conducted according to the guidelines of the State of Delaware and the standards and guidelines set forth by the National Park Service (36 CFR 800;36 CFR 66) and the "Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation"(48 FR 44716-44742).

METHODOLOGY

Field Preparation

Prior to the initiation of fieldwork, a detailed work plan will be developed. A health and safety plan will be prepared according to OSHA regulations (29 CFR Part 1910.120[i]) and will address the manner in which the archaeological field team will deal with potentially hazardous materials anticipated to be present on the site. The project manager and/or field director will coordinate with representatives of Chesapeake Utilities, Consoer Townsend, the Delaware State Historic Preservation Office (SHPO) and other appropriate individuals or agencies.

Field Study

Because of the presence and depth of fill material and the nature of ground cover in the project area, a backhoe will be employed to remove fill material. The location and number of trenches proposed to be excavated will be determined and presented as part of the detailed work plan, based upon the areas and extent of remediation. The purpose of subsurface investigation is to determine the presence, nature, and significance of archaeological resources in these areas and to recover information which will address the research questions with regard to these areas. Excavation will follow OSHA excavation requirements (29 CFR Part 1926) and will be dug at a 1.5:1 slope.

Investigation, if necessary, would be located in the following areas: (1) One trench would be excavated in the location of the older section of the main structure. Soil Borings B-10 and B-12 of the On-site Source Characterization Study were drilled in this location. (2) One trench would be excavated to intercept a gasholder. Soil Boring B-2 of the On-site Source Characterization Study intercepted a gasholder which appears on the 1885 map. Documentation suggests that this gasholder may have been removed; however, subsurface testing will verify this prediction. (3) One trench would be excavated in the location of the former dwelling detected by the geophysical survey at the corner of North and New Streets. No soil borings were drilled in this location. (4) One trench would be excavated in the location of the original retort house to determine whether any remains of this structure are extant. Soil Boring B-1 of the On-site Source Characterization Study was excavated in the vicinity of this structure. (5) One trench would be excavated where it will intercept one of the houses fronting on Bank Street. Detail regarding the extent and location of such excavations will be presented in the Detailed Work Plan.

After the backhoe removes any modern fill and demolition material overlying intact surfaces or features in the selected locations, hand excavation will be employed. Test units will be excavated should intact archaeological surfaces be encountered. Soil will be screened through 1/4-inch mesh hardware cloth. Artifacts will be bagged according to provenience. A bag inventory will be prepared. Profile drawings and photographs will be made for all trenches and units. All features will be drawn and photographed. The location of all trenches and features will be recorded on a site map.

Because of the possibility of encountering potentially hazardous materials, appropriate precautions will have to be employed when conducting Phase IB/Phase IIB/Phase III subsurface archaeological investigation. All personnel engaged in the on site archaeology will be certified in accordance with OSHA requirements (29 CFR Part 1910.120[e]) and will be supervised for the duration of the project by a trained and experienced supervisor. The supervisor will also monitor for hazardous material while the excavations are in progress.

The level of protection necessary will be presented at the time the Detailed Work Plan and Health and Safety Plan are developed. Appropriate protective clothing will be worn and appropriate procedures will be employed.

A backhoe which is certified for excavation on hazardous materials sites will be employed. At the end of each work day equipment used will be decontaminated. The site will be fenced. Trench backfill, site restoration and material removal and/or disposal will be in accordance with the appropriate regulations and the site's remediation plan.

Laboratory Analysis

A field lab will have to be established for decontamination, where feasible, and for the processing of artifacts. All artifacts retrieved will be placed in polyethelene bags according to provenience. An artifact inventory will be prepared and cataloging will occur on a system using dBASE III PLUS.

Report Preparation

Artifact and field data will be analyzed and presented in a report to include sections on historic and prehistoric background, previous investigations, methodology, description and analysis of findings, and conclusions. The report will include profile drawings of all trenches and units. Any features encountered in any of the trenches will be drawn in plan view and photographed. A site map showing the location of the trenches will be included in the report. An artifact inventory will be included in the appendices. The report will be prepared according to federal and state guidelines.